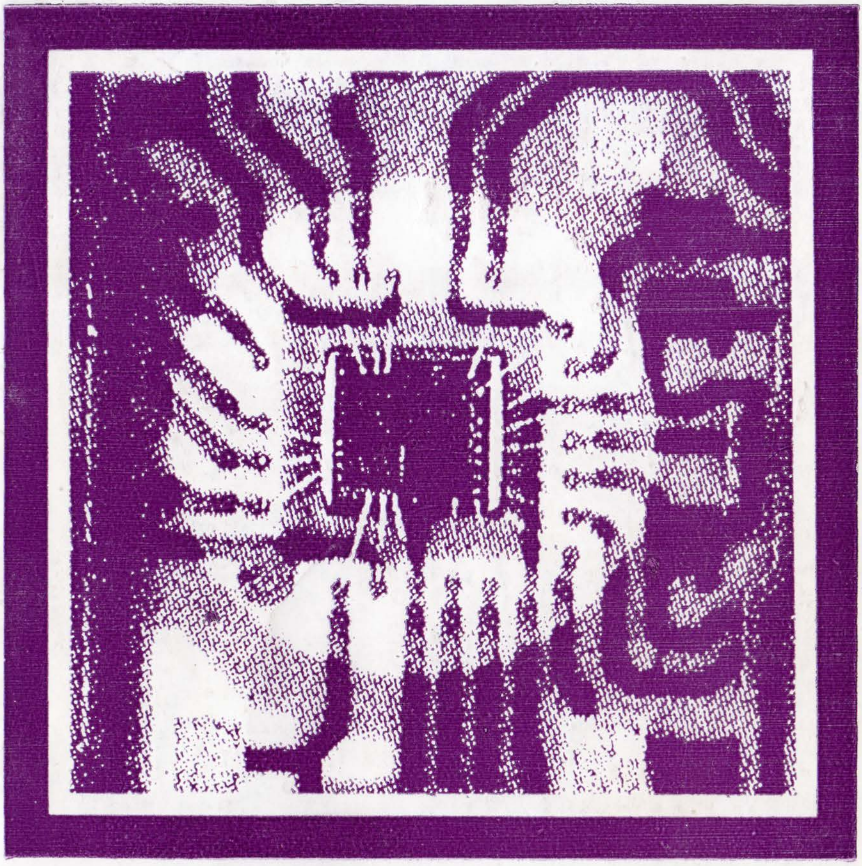
COLECȚIA INFORMATICA



Cornel Goia

FIZICA DE LICEU ÎN LIMBAJ BASIC

EDITURA DACIA

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FIZICA DE LICEU ÎN LIMBAJ BASIC

EDITURA DACIA, CLUJ-NAPOCA, 1993

Pentru obținerea înregistrărilor pe bandă magnetică a programelor prezentate în această lucrare vă puteți adresa autorului, str. Horea nr. 17, Alba Iulia, cod 2500, Jud. Alba, telefon 096—823896.

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PREFAȚĂ

Calculatorul personal se poate întîlni în multe școli, acesta reprezentînd un mijloc de învățămînt nu numai modern dar și foarte util. Liceul unde îmi desfășor activitatea fiind printre primele licee dotate cu calculatoare, am reușit să realizez o serie de programe, care mi-au fost de un real folos în predarea fizicii. Această culegere de programe se adresează însă și profesorilor de alte specialități, elevilor, altor cititori doritori de a se iniția în folosirea limbajului BASIC, mai exact a variantei Beta 3.1.

Am apelat la varianta Beta 3.1 (care este o extensie a limbajului BASIC) datorită în principal următoarelor considerente:

1) *editarea programelor este mai comodă și mai rapidă datorită comenzilor ce permit:*

— autonumerotarea liniilor la introducere (AUTO);
— renumerotarea liniilor cu un pas dorit (RENUM);
— ștergerea liniilor pe blocuri (DELETE);
— unirea liniilor (JOIN);
— despicarea unei linii (SPLIT);
— editarea unei linii (EDIT)

2) *tipărirea caracterelor se poate face și cu instrucțiunea PLOT x,y;"c" (unde x, y sînt coordonatele pixelului din stînga sus), această posibilitate permite scrierea de indici, exponenți, simularea unor mișcări;*

3) *reprezentările grafice în care intervine sinusul sau/și cosinusul se execută mult mai rapid cu funcțiile predefinite SINE sau/și COSE;*

4) *instrucțiunea CSIZE permite tipărirea caracterelor cu dimensiuni variabile, deci și foarte mari (profesorul nu trebuie să uite că*

are elevi și în ultima bancă, iar ecranul televizorului nu are dimensiunile unui ecran de proiecție cinematografică).

Extensia Beta BASIC 3.1 a apărut în anul 1985 și o recomand tuturor posesorilor de calculatoare personale compatibile HC—urilor.

Programele sînt precedate de o sumară prezentare, neintrînd în amănunte pentru a nu răpi satisfacția unor eventuale surprize care apar pe parcursul rulării genericului, sau a programului propriu-zis.

Programele au fost în așa fel realizate încît să se evite complicațiile inutile (la care recurg mulți programatori) pentru a fi într-adevăr utile unui începător.

În paranteze au fost trecute numele programelor, știut fiind că acestea nu pot depăși 10 caractere.

Mulțumesc prietenilor care m-au inițiat în această activitate, celor care m-au ajutat la tipărirea manuscrisului, editurii DACIA din Cluj-Napoca pentru încrederea acordată.

CORNEL GOIA

CUPRINS

Beta BASIC 3.1-Extensie a limbajului BASIC

Cu comanda LOAD" " se încarcă atît liniile BASIC cît și codul mașină. Linia 0 conține definițiile funcțiilor Beta BASIC. Ea este totdeauna în memorie și totdeauna parte componentă a unui program Beta BASIC, deși nu este listată împreună cu programul.

Comanda NEW are un efect mai puțin puternic, ea șterge programul, cu excepția liniei 0.

Principalele instrucțiuni, comenzi și funcții, folosite în realizarea programelor din această culegere, sînt următoarele ;

ALTER (atribute) TO atribute

Modifică atributele ecranului (INK, PAPER, FLASH, BRIGHT)

Exemple :
```
ALTER TO PAPER 2, INK 7, FLASH 1
ALTER INK 7 TO INK 0
ALTER INK 3, BRIGHT 1, PAPER 7 TO INK 5,
FLASH 1
```

ALTER referință TO referință

Modifică referințe. O „referință" înseamnă o variabilă, un număr sau o secvență de semne.

Exemple :
```
ALTER a$ TO b$
ALTER n TO m
ALTER 2 TO 83
ALTER „aici" TO „acolo"
```

AUTO (număr de linie) (,mărime pas)

Atribuie automat numere de linii. Dacă nu se indică mărimea pasului, atunci implicit este 10. Dacă nu se indică nici numărul liniei de început, atunci se începe cu linia curentă plus 10.

Exemple :
```
AUTO
AUTO 100
AUTO 100,5
```

CLOCK număr sau şir
Ceas digital cu alarmă şi GOSUB de alarmă. Numărul poate lua valorile 1, 2, 3, *4*, 5, 6 sau 7.

Mod	Subrutina de alarmă	BEEP de alarmă	Afişare
0	—	—	—
1	—	—	da
2	—	da	—
3	—	da	da
4	da	—	—
5	da	—	da
6	da	da	—
7	da	da	da

Exemple : CLOCK 1
CLOCK "09 : 29 : 45"
CLOCK "a06 : 20"

Semnul „ :" dintre grupele de două cifre poate fi omis. CLOCK preia dintr-un şir numai primele 6 cifre şi ignoră orice altceva în afară de „a" şi „A". În timpul unui BEEP şi la manevrări ale casetei ceasul nu mai merge

CLS (număr de WINDOW)
CLS simplu şterge fereastra curentă. CLS urmat de un număr şterge fereastra definită cu numărul respectiv.

CSIZE lăţime (,înălţime)
Stabileşte mărimea şi distanţa dintre caractere. Lăţimea şi înălţimea sînt indicate în pixeli. Dacă nu indicaţi înălţimea, atunci ea se ia egală cu lăţimea.

Exemple : CSIZE 0
CSIZE 16
CSIZE 8, 16

DEFAULT variabilă = valoare (,variabilă = valoare).....
Are aceeaşi acţiune ca LET dacă variabila precizată nu există şi nici un efect dacă variabila există.

Exemple : 10 LET *a* = 10, *b* = 20
20 DEFAULT a = 60, c$ = "test"
30 PRINT a, b, c$

Acest program tipăreşte 10 pentru a, 20 pentru b şi test pentru c$, valoarea 60 pentru a este ignorată.

Comanda DEFAULT poate sta oriunde în program, dar înainte de toate scopul său este de a atribui valori parametrilor dintr-o procedură care nu apar în lista parametrilor actuali.

DEF KEY caracter ; şir
Defineşte taste funcţionale.
Exemple : DEF KEY "a" ; "Salut :"

DEF KEY caracter : instrucţiune : instrucţiune : ....
Prin apăsarea pe o tastă se obţine o succesiune de comenzi.
Exemple : DEF KEY "b" : PRINT "BETA" : PLOT 56, 82
Cu "LIST DEF KEY" puteţi lista toate atribuirile tastelor.

DEF PROC nume (parametru) (,REF parametru) .....
Începe definirea unei proceduri, trebuie să fie prima instrucţiune dintr-o linie.

DELET (număr linie) TO (număr linie)
Şterge toate liniile blocului indicat.
Exemple : DELET TO 40
DELET TO şterge programul, în afară de linia 0
DELET 0 TO 0 şterge linia 0
DELET 300 TO
DELET poate exista şi în interiorul unui program, pentru a şterge liniile DATA după citirea lor cu READ. În acest mod se eliberează memorie.

DELET nume şir (domeniu)
Şterge şiruri sau părţi ale acestora.
Exemple :

```
10 LET a$ = "123456789"
20 DELET a$ (4 TO 7)
30 PRINT a$
40 DELET a$
50 PRINT a$
```

DO

DO WHILE condiţie

DO UNTIL condiţie

DO şi LOOP singure includ o buclă infinită.
Exemple :

```
10 DO
20 PRINT "test"
30 LOOP
```

DO WHILE (condiţie) execută bucla atunci cînd condiţia este adevărată, şi o repetă atît timp cît condiţia rămîne adevărată.

DO UNTIL (condiție) execută bucla pînă la următorul LOOP numai atunci și numai atît timp cît condiția este falsă.

DRAW TO x, y(,unghi)
Desenează o dreaptă sau un arc de cerc pînă în punctul indicat.
Exemple : DRAW TO 200, 50
DRAW TO 100, 90, 1
DRAW TO INK 1 ; 20, 30

EDIT (număr linie)
Editează linia de program cu numărul indicat.
Exemple : EDIT sau "0" editează linia curentă
EDIT 100

EDIT a$ sau EDIT ; b
Editează o variabilă șir sau o variabilă numerică.
Înainte de variabila numerică este necesar caracterul " ;", pentru a deosebi EDIT (variabilă) de EDIT (număr de linie).
Exemple : LET a$ = "fizica" ; EDIT a$: PRINT a$
LET n=456 : EDIT ; n : PRINT n

END PROC
Termină definirea unei proceduri. Eventualele variabile locale se șterg și cele globale cu nume identice primesc înapoi valoarea lor anterioară.

EXIT IF (condiție)
Se utilizează pentru a părăsi un DO—LOOP, dacă condiția este îndeplinită.
Exemple :

```
10 LET i=0
20 DO
30 LET i=i + 1
40 PRINT "fizică",
50 EXIT IF i=20
60 LOOP
```

FILL x,y
FILL (INK culoare) x,y
Umple un domeniu continuu de culoare PAPER cu culoarea INK.
Exemple : CIRCLE 100, 100, 20 : FILL 100, 100
CIRCLE INK 2 ; 100 ,100, 20 : FILL INK 2 ; 100, 100

FILL (PAPER culoare) x, y
Colorează un domeniu de culoare INK în culoarea PAPER. Această comandă nu șterge linii diagonale, ci numai linii verticale sau orizontale.

GET variabilă-șir sau numerică

Citește un caracter de la tastatură, fără a aștepta ENTER, dar așteaptă pînă cînd este apăsată tasta respectivă, după care continuă execuția.

Exemple: 10 GET a$: PRINT a$: GO TO 10

Cu acest program lucrează ca o mașină de scris.

GET a$, x, y, (,lățime, înălțime) (; tip)

Atribuie șirului indicat un domeniu dreptunghiular al ecranului, de coordonate stînga—sus x, y, care apoi poate fi afișat cu PRINT sau PLOT în altă parte a ecranului. Înălțimea și lățimea se indică în număr de caractere. Tipul poate fi 0, adică „incolor", sau 1 de culoare proprie. Un șir de tip 1 preia, în afară de informația conținută în pixeli, și informația asupra atributelor de pe ecran.

Exemple:
```
10 FOR i=1 TO 20
20 PRINT "test"
30 NEXT i
40 GET a$, 175, 175, 5, 1 ; 1
50 PAUSE 100 : CLS
60 PLOT 50, 50 ; a$
```

JOIN (număr linie)

JOIN unește linia actuală cu linia imediat următoare.

JOIN 100 unește linia 100 cu linia imediat următoare liniei 100.

Aceste uniri economisesc 4 octeți și crește viteza de execuție a programului.

JOIN a$ (slicer) TO b$ (poziție)

Unește un șir origine cu un șir destinație, sau un anumit domeniu (slicer) al primului șir cu șirul destinație (într-o anumită poziție).

Exemple:
```
10 LET a$="12345"
20 LET b$="abcdefg"
30 JOIN a$ TO b$
40 PRINT b$          — tipărește "abcdefg12345"
50 PRINT a$          — nu s-a găsit!
```

JOIN a (slicer) TO b (poziție)

Unește tabloul origine a cu tabloul destinație b. Tablourile în mod deosebit sînt destinate pentru a purta cantități mari de informație, motiv pentru care se dimensionează de la început destul de mari, dar prin aceasta blocăm spațiu de memorie prețios, uneori nefolosit integral. Cu JOIN se poate deplasa un tablou sau părți ale acestuia în poziții la alegere din alt tablou.

Presupunem că avem un tablou-șir a$ (100, 30), care este plin cu date, dar mai avem nevoie de loc pentru încă 20 de șiruri în acest tablou:

DIM b$ (20, 30) : JOIN b$ TO a$
Șirurile tabloului b$ sînt transferate în a$, iar b$ se șterge.

KEYWORDS număr
Modul de introducere și listare a cuvintelor cheie.
Exemple: KEYWORDS 0, afișează caracterele UDG
KEYWORDS 1, afișează noile cuvinte cheie din Beta BASIC
KEYWORDS 2, cuvintele cheie sînt introduse sub forma a cîte unui cod
KEYWORDS 3, linia introdusă este verificată dacă conține cuvinte cheie în forma extinsă (scrisă).
KEYWORDS 4, aici nu există cursor K, instrucțiunile pot fi introduse literă cu literă.

LET variabilă = valoare (,variabilă=valoare)....
Este un LET multiplu.
Exemple: 10 LET x=1, y=2, a$="test"

LIST (număr de linie) TO (număr de linie)
Se listează blocul de linii program indicat.
Exemple: LIST 20 TO 100
LIST TO 300
LIST TO
LIST 300 TO

LIST DATA, LIST VAL, LIST VAL$
Listează conținutul actual al variabilelor.
Exemple: LIST DATA, listează toate valorile variabilelor.
LIST VAL, listează toate valorile variabilelor numerice.
LIST VAL$ listează toate valorile variabilelor șir.

LIST DEF KEY
Arată conținutul acoperirii tastelor funcționale, în ordinea alfabetică. Întîi este tipărită cifra sau litera tastei, apoi conținutul.

LIST FORMAT număr
Listarea se poate efectua în mai multe moduri, după cum numărul ia una din valorile: 0, 1, 2, 3, 4 sau 5.

LIST PROC nume

Listează procedura cu numele indicat.

LIST REF referință

Listează numerele liniilor în care apare o referință indicată. Ca referință se poate introduce un nume de variabilă, un număr sau o succesiune de caractere.

LOCAL variabilă (,variabilă).....

Definește variabile speciale, care există numai în interiorul unor proceduri definite. Variabilele locale din interiorul unei proceduri nu influențează variabilele care existau înainte de apelul procedurii, chiar avînd același nume. Subprocedurile pot avea, la rîndul lor, declarații de variabile locale.

LOOP
LOOP WHILE condiție
LOOP UNTIL condiție

Termină o buclă DO—LOOP. LOOP WHILE condiție revine la DO numai atunci cînd condiția este adevărată. LOOP UNTIL condiție, revine la DO cînd condiția nu este adevărată

ON

Exemple: GO TO ON x ;număr linie, număr linie, ...
GO SUB ON x ;număr linie, număr linie, ...

Permite ramificarea la linii dintr-o listă de numere de linii, dependent de valoarea unei expresii de după cuvîntul cheie ON.

ON x : instrucțiune : instrucțiune : ..

Permite alegerea unei instrucțiuni dintr-o listă de instrucțiuni, depinzînd de valoarea expresiei de după ON.

ON ERROR număr linie

Indică un număr de linie, la care sare programul cînd apare o eroare.

ON ERROR : instrucțiune : instrucțiune : . . .

Instrucțiunile sînt prelucrate ca subrutină în caz de eroare.

PLOT x,y (;șir)

Permite să aduceți în orice poziție a ecranului, nu numai puncte, ci șiruri întregi. Coordonatele definesc colțul stînga—sus al primului caracter.

POKE adresă, şir

Puteţi depozita în memorie, la adresa indicată, în afară de numere de la 0 la 255, şi şiruri. Primul caracter se memorează la adresa indicată, al doilea la adresa +1 etc.

PROC nume (parametru) (,parametru) ..

Pentru a apela procedura nu este necesar cuvîntul cheie PROC. O procedură poate fi apelată doar prin introducerea numelui ei. Cu această instrucţiune puteţi transmite şi o listă de parametrii în apelul procedurii.

READ LINE a$ (,b$) ...

Citeşte şiruri fără ghilimele. Puteţi introduce mult mai simplu instrucţiuni DATA.

REF referinţă

Se caută în tot programul o referinţă specificată. Referinţa este o variabilă, un număr sau o succesiune de caractere. Dacă se găseşte această referinţă, atunci apare linia de program respectivă în zona INPUT a ecranului, cu cursorul după referinţă.

*RENUM(*) (slicer) (LINE număr de linie) (STEP pas)*

Permite ca un program sau părţi ale acestuia să fie prevăzute cu noi numere de linie şi ca părţi de program să fie deplasate sau copiate. Prin RENUM * blocul nu se şterge din vechea poziţie, ci doar se copiază în noua poziţie.

Exemple : RENUM
RENUM LINE 100 STEP 5
RENUM 40 TO 100
RENUM TO 100

ROLL direcţia (,pixel) (;x,y ;lăţime înălţime)

Deplasează imaginea sau părţi dreptunghiulare oarecare cu un număr de pixeli care se poate indica, în sus, în jos, la stînga sau la dreapta. Ce se pierde la o margine apare pe ecran în partea opusă. Codul de direcţie poate lua valori între 1 şi 12, după cum dorim să deplasăm numai atributele, numai pixelii sau ambele. Coordonatele x şi y sînt ale colţului stînga—sus, lăţimea este măsurată în poziţii PRINT (de la 1 la 32), iar înălţimea măsurată în pixeli.

SCROLL (direcţie) (,nr. pixeli) (;x,y; lăţime înălţime)

Ca şi ROLL, dar ce iese se distruge.

SORT a$ *sau a (slicer) (slicer)*
Sortează şiruri, numere sau litere în ordine crescătoare sau descrescătoare (SORT INVERSE).

TRACE număr de linie
Ramifică programul, înaintea execuţiei unei instrucţiuni BASIC, la un număr de linie indicat ca subrutină.

TRACE : instrucţiune : instrucţiune : ... :RETURN
Se execută ca subprogram comenzile aflate după TRACE, înainte de execuţia fiecărei instrucţiuni BASIC.
Exemple : TRACE : LIST lino TO lino : PAUSE 0 : RETURN
Se listează linia care tocmai se execută.

USING în PRINT USING a$, număr
Permite extragerea numerelor într-un anumit format. În şirul format se pune caracterul „ #" înaintea punctului zecimal pentru cifre sau spaţii, şi caracterul "Ø" pentru cifre. După punctul zecimal, aceste caractere reprezintă poziţiile corect rotunjite de după virgulă.

WINDOW nr. fereastră (,x,y, lăţime, înălţime)
Stabileşte anumite domenii de ecran dreptunghiulare ca fiind „ferestre". Ca număr al ferestrei este permis orice număr întreg între 0 şi 127 inclusiv. WINDOW 0 este definiţia pentru tot ecranul. Lăţimea şi înălţimea se exprimă în pixeli.
Exemple : WINDOW 1, 0, 175, 128, 176
Apelul se face cu WINDOW 1.
Cu WINDOW ERASE se şterg toate definiţiile de WINDOW.

BIN$ (număr)
Această funcţie transformă un număr între 0 şi 255 într-un şir de 8 caractere şi un număr între 256 şi 65535 într-un şir de 16 caractere. Acest şir conţine numărul în reprezentare binară.

COSE (număr)
Dă cosinusul numărului, cu precizie mai mică decît COS, dar de 6 ori mai repede. Este deci ideal pentru reprezentări grafice,

INSTRING (start, şir 1, şir 2)
Caută în şir 1 existenţa lui şir 2, începînd cu poziţia start. Rezultatul este poziţia primului caracter din şir 2 în şir 1 ; dacă nu s-a găsit şir 2, rezultatul este 0.

LENGTH (n, "nume tablou")

Se obțin informații în legătură cu mărimea unui tablou. Cu $n = 1$ se obține lungimea primei dimensiuni, cu $n = 2$ lungimea celei de-a doua dimensiuni.

MEM ()

Dă numărul de octeți liberi din memorie.

SINE (număr)

Furnizează rapid sinusul unui număr.

1. FENOMENE MECANICE

1.1. MIŞCAREA RECTILINIE UNIFORMĂ („UNIFORMA")

Prin generic se simulează mişcarea rectilinie uniformă. Şiruri de caractere, sau caractere, se mişcă rectiliniu şi uniform după diferite direcţii, aranjîndu-se în aşa fel încît se tipăreşte în final „Mişcarea rectilinie uniformă".

După o prezentare a legii mişcării şi a semnificaţiei fizice a mărimilor care intervin în ea, se simulează mişcarea rectilinie uniformă cu caracterul „0", acesta deplasîndu-se în lungul axei OX, fie în acelaşi sens, fie în sens contrar. Simultan cu deplasarea caracterului „0" se reprezintă grafic legea mişcării pentru trei cazuri particulare, cronometrarea făcîndu-se în apropierea axei orizontale.

În final se cere elevilor să determine viteza de deplasare a unui caracter între două poziţii, intervalul de timp fiind afişat pe ecran. Pentru determinarea acestui interval de timp, s-au folosit adresele contorului de cadre.

Acest prim program demonstrează utilitatea tipăririi caracterelor, sau a şirurilor de caractere, cu instrucţiunea PLOT.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16, 24
90 PRINT FLASH 1; AT 3, 5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8, 16
120 FOR y=175 TO 120 STEP
   -1
130 PLOT 45, y; "MISCAREA"
140 NEXT y
150 FOR y=0 TO 120
160 PLOT 120, y; "RECTILI-
   NIE"
170 NEXT y
180 FOR x=0 TO 90
190 PLOT x, 90; "U"
200 NEXT x
210 BEEP .1,25
```

```
220 FOR y=0 TO 90
230 PLOT 100,y;"N"
240 NEXT y
250 BEEP .1,25
260 FOR y=175 TO 90 STEP
    -1
270 PLOT 110,y;"I"
280 NEXT y
290 BEEP .1,25
300 FOR y=0 TO 90
310 PLOT 120,y;"F"
320 NEXT y
330 BEEP .1,25
340 FOR x=245 TO 130 STEP
    -1
350 PLOT x,90;"O"
360 NEXT x
370 BEEP .1,25
380 FOR y=0 TO 90
390 PLOT 140,y;"R"
400 NEXT y
410 BEEP .1,25
420 FOR x=245 TO 150 STEP
    -1
430 PLOT x,90; "M"
440 NEXT x
450 BEEP .1,25
460 FOR x=250 TO 160 STEP
    -1
470 PLOT x,250-x; "A"
480 NEX x
490 BEEP .1,25
500 FOR y=175 TO 137 STEP
    -1
510 PLOT 0,y;" * * * * * *
    * * *"
520 NEXT y
530 FOR y=0 TO 72
540 PLOT 0, y;"  * * * * * *
    * * *"
550 NEXT y
560 FOR i=1 TO 16
570 BEEP .1,RND *30
580 PLOT 35+10 *i, 50; z$(i)
590 NEXT i
600 PAUSE 50
610 PLOT 30,140: DRAW
    0,-110
620 DRAW 190,0: DRAW
    0,110
630 DRAW -190,0
640 PAUSE 100
650 BEEP .4,19: BEEP .2,23
660 BEEP .4,28: BEEP .2,26
670 BEEP .4,24: BEEP .2,23
680 BEEP .4,21: BEEP .2,23
690 BEEP .4,24: BEEP .2,26
700 BEEP .4,23: BEEP .2,21
710 BEEP .2,21: BEEP .2,19
720 BEEP .2,23: BEEP .4,26
730 BEEP .2,26
740 PAUSE 100
750 DATA 127, 39, 56, 55, 32,
    76, 72, 67, 67, 32, 67, 46, 71,
    79, 73, 65
760 FOR i=1 TO 160: SCROLL
    7: NEXT i
770 PLOT 0,16; "Vectorul vi-
    teză este v=constant"
780 PLOT 166,19: DRAW 10,0
790 DRAW -4,2: DRAW
    0,-4
800 DRAW 4,2
810 FOR i=1 TO 148
820 ROLL 7: NEXT i
830 FOR x=255 TO 10 STEP
    -1
840 PLOT x,140; "Legea miș-
    cării: x=xo+v(t-to)"
850 NEXT x
860 FOR y=0 TO 115
870 PLOT 0,y; "Unde:"
880 NEXT y
890 FOR y=0 TO 100
900 PLOT 30,y; "x-coordo-
    nata la momentul t"
910 NEXT y
```

```
920 FOR y=0 TO 80
930 PLOT 30,y ; "xo-coordo-
    nata la momentul to"
940 NEXT y
950 FOR y=0 TO 60
960 PLOT 30,y ;"v-viteza"
970 NEXT y
980 FOR x=255 TO 5 STEP
    -1
990 PLOT x,35 ;"Dacă to=0,
    legea mişcării este :"
1000 NEXT x
1010 FOR y=0 TO 15
1020 PLOT 90,y ;"x=xo+vt"
1030 NEXT y
1040 PAUSE 0
1050 CLS : CSIZE 8,16
1060 PLOT 0,170 ;"LEGEA
     MISCARII"
1070 PLOT 42,150 ;"se poate re-
     prezenta"
1080 PLOT 190,130 ;"GRAFIC"
1090 PLOT 40,90 ;"1)to=0 ;
     xo=0 ; v>0"
1100 PLOT 40,70 ;"2)to=0 ;
     xo>0 ;v>0"
1110 PLOT 40,50 ;"3)to=0 ;
     xo>0 ;v<0"
1120 PRINT #0 ; "Ce exemplu
     doriti ?"
1130 PAUSE 0 : CSIZE 0
1140 IF INKEY$="1" THEN
     GO TO 1180
1150 IF INKEY$="2" THEN
     GO TO 1300
1160 IF INKEY$="3" THEN
     GO TO 1420
1170 IF INKEY$<>"1" OR
     INKEY$<>"2" OR IN-
     KEY$<>"3" THEN GO
     TO 1050
1180 CLS: GO SUB 1650
1190 PRINT AT 9,4 ;"to=0 ;
     xo=0 ;v>0"
1200 PRINT #0 ;"Determinati
     viteza !"
1210 POKE 23673,0 : POKE
     23672,0
1220 FOR y=23 TO 160 STPE
     .4
1230 PRINT AT 20,23 ;"t=" ;
     USING "00.0" ;(256 *
     PEEK 23673+PEEK
     23672)/50 ;"s"
1240 PLOT 10,y+5 ;"o"
1250 PLOT (23+210/127 *
     (y-23)),y
1260 NEXT y
1270 PLOT OVER 1 ;10,165 ;
     "o"
1280 PAUSE 0 : CLS
1290 GO TO 1050
1300 CLS : GO SUB 1650
1310 PRINT AT 4,4 ;"to=0 ;
     xo>0 ;v>0"
1320 PRINT #0 ; "Determinati
     viteza !"
1330 POKE 23673,0 : POKE
     23672,0
1340 FOR y=50 TO 160 STEP
     .5
1350 PRINT AT 20,23 ;"t=" ;
     USING "00.0" ;(256 *
     PEEK 23673+PEEK
     23672)/50 ;"s"
1360 PLOT 10,y+5 ;"o"
1370 PLOT (20+20/11 *
     (y-50)),y
1380 NEXT y
1390 PLOT OVER 1 ;10,165 ;
     "o"
1400 PAUSE 0 : CLS
1410 GO TO 1050
1420 CLS : GO SUB 1650
1430 PRINT AT 15,4 ;"to=0
     xo>0 ;v<0"
```

```
1440 PRINT #0; "Determinati
     viteza !"
1450 POKE 23673,0 POKE
     23672,0
1460 FOR y=160 TO 23 STEP
     -.6
1470 PRINT AT 20,23;"t=";
     USING "00.0";(256 *
     PEEK 23673+PEEK
     23672)/50;"s"
1480 PLOT 10,y+5;"o"
1490 PLOT (20-210/137 *
     (y-160)),y
1500 NEXT y
1510 PLOT OVER 1;10,28;"0"
1520 PAUSE 0
1530 INPUT "Doriti reluarea?
     (d/n)";s$
1540 IF s$="d" OR s$<>"n"
     THEN RUN 1050
1550 CSIZE 8,16: CLS
1560 PRINT AT 9,0;"Aflati vi-
     teza urmatoarei miscari"
1570 PAUSE 0
1580 POKE 23673,0: POKE
     23672,0
1590 FOR x=0 TO 247
1600 PLOT 0,80;" * "
1610 PLOT x,80;" * "
1620 PRINT AT 3,8;"t=";
     USING "00.0";(256 *
     PEEK 23673+PEEK
     23672)/50; "s"
1630 >NEXT x
1640 PAUSE 0: CLS : GO TO
     1750
1650 PLOT 15,20: DRAW 235,0
1660 DRAW -5,3: DRAW 0,-6
1670 DRAW 5,3
1680 PLOT 20,10: DRAW 0,160
1690 DRAW 3,-5: DRAW
     -6,0
1700 DRAW 3,5
1710 PRINT AT 0,3;"x"
1720 PRINT AT 20,3;"O"
1730 PRINT AT 20,14;"x=f(t)"
1740 RETURN
1750 LET a$="HC-85"
1760 LET b$="VA DORESTE
     NOTE"
1770 LET c$="MARI LA FI-
     ZICA!"
1780 FOR i=1 TO 5
1790 BEEP .1,RND *30
1800 PLOT 90+i *10,130;a$(i)
1810 NEXT i
1820 FOR i=1 TO 15
1830 BEEP .1,RND *30
1840 PLOT 40+i *10,110;b$(i)
1850 >NEXT i
1860 FOR i=1 TO 15
1870 BEEP .1,RND *30
1880 PLOT 40+i *10,90;c$(i)
1890 NEXT i
1900 PAUSE 0: STOP
1910 SAVE "Uniforma" LINE 10
```

1.2. MIȘCAREA RECTILINIE UNIFORM VARIATĂ („ACCELERATĂ")

Imediat după generic sînt tipărite ecuațiile vitezei, mișcării și ecuația lui Galilei.

Pe același sistem de axe de coordonate se reprezintă grafic atît legea vitezei cît și legea mișcării. Rulînd programul se observă că parabola, care reprezintă legea mișcării, prezintă un minim sau un

maxim la momentul în care viteza este zero, respectiv cînd dreapta $v = f(t)$ intersectează axa timpului.

Pentru o mișcare rectilinie uniform accelerată simulată, calculatorul tipărește timpul, iar elevii după o prealabilă măsurare a spațiului parcurs (cu ajutorul unei rigle), vor determina accelerația mișcării și viteza finală. Aceste două mărimi vor depinde de dimensiunile ecranului.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CZISE 8,16
120 LET a$="MISCAREA
    RECTILINIE"
130 FOR i=1 TO 19
140 BEEP .1,RND *30
150 PLOT25+i *10,110;a$(i)
160 NEXT i
170 LET b$="UNIFORM
    ACCELERATA"
180 PAUSE 100
190 FOR i=1 TO 18
200 BEEP .1,i *2
210 PLOT 30+i *10,90;b$(i)
220 PAUSE 100/i
230 NEXT i
240 PAUSE 100
250 FOR i=1 TO 16
260 BEEP .1,RND *30
270 PLOT 40+i *10,60;z$(i)
280 NEXT i
290 CSIZE 0
300 FOR i=1 TO 10
310 BEEP .1,RND *30
320 PLOT 20,140-i *10;" *"
330 NEXT i
340 FOR i=.1 TO 21
350 BEEP .1,RND *30
360 PLOT 20+i *10,40;" *"
370 NEXT i
380 FOR i=1 TO 9
390 BEEP .1,RND *30
400 PLOT 230,40+i *10; " *"
410 NEXT i
420 FOR i=1 TO 20
430 >BEEP .1,RND *30
440 PLOT 230-i *10,130;" *"
450 NEXT i
460 PLOT 20,130: DRAW
    0,-100
470 DRAW 220,0
480 DRAW 0,100 DRAW
    -220,0
490 PAUSE 100
500 BEEP .4,19 BEEP .2,23
510 BEEP .4,28: BEEP .2,26
520 BEEP .4,24: BEEP .2,23
530 BEEP .4,21: BEEP .2,23
540 BEEP .4,24: BEEP .2,26
550 BEEP .4,23: BEEP .2,21
560 BEEP .2,21: BEEP .2,19
570 BEEP .2,23: BEEP .4,26
580 BEEP .2,26
590 PAUSE 100
600 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
610 FOR i=1 TO 160: SCROLL
    7 NEXT i
620 >PLOT 20,170 MISCA-
    REA RECTILINIE UNI-
    FORM"
```

```
630 PLOT 36, 160 ;"VARIATA,
    ARE URMATOAREI.E
640 PLOT 90,150 ;"ECUATII :"
650 PLOT 40,130 ;1)ECUATIA
    VITEZEI :"
660 PLOT 70,110 ;"v=v +at"
670 PLOT 94,106 ;"o"
680 PLOT 40,90 ;"2) ECUATIA
    MISCARII :"
690 PLOT 70,70 ;"x=x +v
    t+—at"
700 PLOT 94,66 ; "o"
710 PLOT 118,66 ; "o"
720 PLOT 142,75 ;"1"
730 PLOT 142,65 ;"2"
740 PLOT 166,74 ;"2"
750 PLOT 40,50 ;"3)ECUATIA
    LUI GALILEI :"
760 PLOT 70,30 ;"v=v +2a
    (x—x)"
770 PLOT 78,34 ;"2"
780 PLOT 102,34 ;"2"
790 >PLOT 102,26 ;"o"
800 PLOT 166,26 ;"o"
810 PAUSE 0 ; CLS
820 PRINT #1 ;AT 0,0 ;"GRA-
    FICUL ECUATIEI VITE-
    ZEI SI"
830 PRINT # ;AT 1,0 ;"MIS-
    CARII UNIFORM ACCE-
    LERATE"
840 PAUSE 100
850 PLOT 100,10 : DRAW
    0,160
860 DRAW 2,—5 : DRAW —4,0
870 DRAW 2,5
880 PLOT 85,170 ;"x"
890 PLOT 109,170 ;"v"
900 PLOT 90,19 ;"0"
910 PAUSE 100
920 PLOT 10,20 : DRAW
    240,0
930 DRAW —5,2 : DRAW 0,—4
940 DRAW 5,2
950 PLOT 240,30 ;"t"
960 PAUSE 100
970 FOR x=—80 TO 0 STEP 5
980 >PLOT x+100,60+.5 *x+
    +1/160 *(ABS x)^2
990 PLOT x+100,30+.25 *x
1000 NEXT x
1010 FOR x=0 TO 140 STEP .5
1020 IF x<100 THEN PLOT
x+100,60+.5 *x+1/160 *x^2
1030 PLOT x+100,30+.25 *α
1040 NEXT x
1050 PLOT 170,120 ;"x"
1060 PLOT 180,45 ;"v"
1070 PAUSE 100
1080 PLOT 80,70 ;"xo"
1090 PLOT 80,40 ;"vo"
1100 PAUSE 100
1110 FOR x=60 TO 100 STEP 5
1120 PLOT x,50
1130 NEXT x
1140 PLOT 102,5 ;"xm"
1150 PAUSE 100
1160 FOR y=50 TO 20 STEP—5
1170 PLOT 60,y : NEXT y
1180 >PLOT 40,30 ;"tm"
1190 PAUSE 100
1200 PLOT 200,120 ;"a>0"
1210 PLOT 200,110 ;"v >0"
1220 PAUSE 0 : CLS
1230 PRINT #1 ; AT 0,0 ;
     "GRAFICUL VITEZEI
     ȘI MISCARII UNI"
1240 PRINT #1 ;AT 1,0 ;
     "FORM INCETINITE,
     APOI ACCELERATE"
1250 PAUSE 100
1260 PLOT 40,10 : DRAW
     0,160
1270 DRAW 2,—5 : DRAW —4,0
1280 DRAW 2,5
1290 PLOT 25,170 ;"x"
1300 PLOT 50,170 ;"v"
1310 PLOT 30,19 ;"O"
```

```
1320 PAUSE 100
1330 PLOT 0,20: DRAW
     250,0
1340 DRAW -5,2 : DRAW 0, -4
1350 DRAW 5,2
1360 PLOT 240,35 ;"t"
1370 PAUSE 100
1380 >FOR x=-40 TO 0 STEP 5
1390 PLOT x+40,90+1.4 *x
     -.007 *(ABS x)^2
1400 PLOT x+40,40-.2 *x
1410 NEXT x
1420 FOR x=0 TO 200 STEP
     .5
1430 PLOT x+40,90+1.4 *x-
     .007 *x^2
1440 IF x<180 THEN PLOT
     x+40,40-.2 *x
1450 NEXT x
1460 PAUSE 100
1470 PLOT 220,130 ;"x"
1480 PLOT 90,40 ;"v"
1490 PAUSE 100
1500 PLOT 45,95 ;"xo"
1510 PLOT 45,50 ;"vo"
1520 PAUSE 100
1530 FOR x=140 TO 40STEP -5
1540 PLOT x, 160
1550 NEXT x
1560 PLOT 45,159 ;"xm"
1570 PAUSE 100
1580 >FOR y=160 TO 20 STEP
     -5
1590 PLOT 140,y
1600 NEXT y
1610 PLOT 145,30 ;"tm"
1620 PAUSE 100
1630 PLOT 80,80 ;"a<0"
1640 PLOT 80,70 ;"v >0"
1650 PAUSE 100
1660 PLOT 170,80 ;"a<0"
1670 PLOT 170,70 ;"v<0"
1680 PAUSE 0 : CLS
1690 CSIZE 8,16
1700 PRINT AT 0,0 ;"AFLATI
     ACCELERATIA MISCA-
     RII!"
1710 PRINT AT 1,0 ; "AFLATI
     VITEZA FINALA!"
1720 PAUSE 500
1730  POKE 23673,0 : POKE
     23672,0
1740 FOR t=0 TO 5
1750 PLOT 9.9 *t^2,85 ;" * "
1760 >PRINT AT 10,10 ;"t=" ;
     USING "0.0" ;(256 *PEEK
     23673+PEEK 23672)/50 ;
     "secunde"
1770 NEXT t
1780 PAUSE 0 : STOP
1790 SAVE "Accelerata" LINE
     10 .
```

1.3. ARUNCAREA OBLICĂ A UNUI CORP („OBLICĂ")

În generic este simulată aruncarea oblică cu ajutorul caracterelor din şirul „OBLICA" .

Programul permite reprezentarea traiectoriilor a 7 corpuri aruncate oblic în vid, sub unghiuri diferite, cu aceeaşi viteză iniţială. Al 4-lea corp este aruncat sub un unghi de 45 grade, iar primele trei şi ultimele trei, sub unghiuri care scad sau cresc cu aceeaşi valoare. Se

constată că bătaia maximă este pentru 45 grade, iar peste și sub această valoare cu același număr de grade, apar bătăi egale.

La concluziile de mai sus se poate ajunge rulînd și partea a doua a programului, în care, pentru o viteză inițială de 350 m/s și diferite unghiuri de aruncare se calculează bătaia.

```
10 >BORDER 2 : PAPER 6
20 INK 1 : CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1 ;AT
   3,5 ;"READY"
100 PAUSE 0 : CLS
110 CSIZE 8,16
120 LET a$="ARUNCAREA"
130 FOR i=1 TO 9
140 BEEP .1,RND *30
150 PLOT 40+i *10,50 ;a$(i)
160 NEXT i
170 LET b$="OBLICA"
180 FOR i=1 TO 6
190 FOR a=0 TO PI STEP .1
200 >PLOT 70+i *5-(70+i *
    *5) *COSE(a),50+(70+i
    *5) *SINE(a) ;b$(i)
210 PAUSE 2
220 PLOT OVER 1 ;70+i *5-
    (70+i *5) *COSE(a),50+
    (70+i *5) *SINE(a) ;b$(i)
230 NEXT a
240 PLOT 140+i *10,50 ;b$(i)
250 BEEP .1,RND *30
260 NEXT i
270 FOR i=1 TO 16
280 BEEP .1,RND *30
290 PLOT 40+i *10,30 ;z$(i)
300 NEXT i
310 FOR y=1 TO 60
320 ROLL 7
330 NEXT y
340 PAUSE 50
350 FOR i=1 TO 6
360 BEEP .1,RND *30
370 PLOT 40,156-i *16 ;" * "
380 NEXT i
390 >FOR i=1 TO 17
400 BEEP .1,RND *30
410 PLOT 40+i *10,60 ;" * "
420 NEXT i
430 FOR i=1 TO 5
440 BEEP .1,RND *30
450 PLOT 210, 60+i *16 ;" * "
460 NEXT i
470 FOR i=1 TO 17
480 BEEP .1,RND *30
490 PLOT 220-i *10,140 ;" * "
500 NEXT i
510 PAUSE 50 : PLOT 38, 142
520 DRAW 0,-100
530 DRAW 182,0
540 DRAW 0,100 DRAW
    -182,0
550 PAUSE 100
560 DATA 127,39,56,55,32,76,72
    67,67,32,67,46,71,79,73,65
570 BEEP .4,19 BEEP .2,23
580 BEEP .4,28 : BEEP .2,26
590 BEEP .4,24 : BEEP .2,23
600 >BEEP .4,21 BEEP .2,23
610 BEEP .4,24 BEEP .2,26
620 BEEP .4,23 BEEP .2,21
630 BEEP .2,21 BEEP .2,19
640 BEEP .2,23 : BEEP .4,26
650 BEEP .2,26
660 PAUSE 100
670 FOR i=1 TO 175: SCROLL
    7 : NEXT i
680 CSIZE 0 : CLS
```

```
690 PRINT #0;"TRAIECTO-
    RIILE A 7 CORPURI
    ARUNCATE OBLIC CU
    ACEEASI VITEZA"
700 FOR x=0 TO 255
710 FOR a=PI/16 TO PI/2
    STEP PI/16
720 LET y=x*SINE(a)/
    COSE(a)-x^2/(510
    (COSE(a))^2)
730 IF y>1  THEN PLOT x,y
    +8
740 NEXT a
750 NEXT x
760>PRINT AT 0,2;"TRAIEC-
    TORIILE SINT PARA-
    BOLE"
770 PAUSE 100
780 PRINT A  2,10; "Al 4-lea
    corp este"
790 PRINT AT 3,12; "aruncat
    sub un"
800 PRINT AT 4,10; "unghi de
    45 grade"
810 PAUSE 0: CLS
820 CSIZE 8,16
830 LET a$="INCERCATI SA
    AFLATI"
840 LET b$="PENTRU CE
    UNGHI DE"
850 LET c$="ARUNCARE
    BATAIA ESTE"
860 LET d$="MAXIMA!"
870 FOR i=1 TO 19
880 BEEP .1,RND*30
890 PLOT 20+i*10,130;a$(i)
900 NEXT i
910 FOR i=1 TO 18
920>BEEP .1,RND*30
930 PLOT 25+i*10,110;b$(i)
940 NEXT i
950 FOR i=1 TO 20
960 BEEP .1,RND*30
970 PLOT 15+i*10,90;c$(i)
980 NEXT i
990 FOR i=1 TO 7
1000 BEEP .1,RND*30
1010 PLOT 80+i*10,70;d$(i)
1020 NEXT i
1030 PAUSE 300: CSIZE 0
1040 CLS
1050 PRINT AT 0,9; "vo=350
     m/s"
1060 PRINT
1070 PRINT "Unghiul a", "Ba-
     taia b"
1080 PRINT "(in grade)", "(in
     metrii)"
1090 PRINT "==========
     ======"
1100>INPUT "Introduceti un-
     ghiul a=";LINE a$
1110 FOR i=1 TO LEN a$
1120 IF CODE a$(i)<46 OR
     CODE a$ (i)>57 THEN
     GO TO 1100
1130 IF CODE a$(i)=47 THEN
     GO TO 1100
1140 NEXT i
1150 LET a=VAL a$
1160 IF a<0 OR a>90 THEN
     PRINT #1;"Unghiul apar
     tine [0,90]": PAUSE 200:
     GO TO 1100
1170 PRINT   a,1/9.8*350^2*
     SIN (a*PI/90)
1180 GO TO 1100
1190 SAVE "Oblica" LINE 10
```

1.4. ARUNCAREA ORIZONTALĂ A UNUI CORP („ORIZONTALĂ")

În generic este simulată aruncarea orizontală cu ajutorul caracterelor din şirul „ORIZONTALA".

Programul reprezintă traiectoriile unor corpuri aruncate pe orizontală, în vid, de la aceeaşi înălţime, cu viteze diferite. Introducînd viteza de aruncare şi înălţimea, calculatorul afişează timpul de coborîre, distanţa parcursă pe orizontală şi viteza finală.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z $(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="ARUNCAREA"
130 FOR i=1 TO 9
140 BEEP .1,RND *30
150 PLOT 24+i *8,50;a$(i)
160 NEXT i
170 LET b$="ORIZONTALA"
180 FOR i=1 TO 10
190 FOR x=1 TO 102+i *9
    STEP 9
200 LET y=160-110/(110+i *
    9)^2 *x^2
210 >PLOT x,y;b$ (i)
220 PAUSE 4
230 PLOT OVER 1;x,y;b$(i)
240 NEXT x
250 BEEP .1,30
260 PLOT 102+i *9,50;b$(i)
270 NEXT i
280 PAUSE 50
290 FOR i=1 TO 16
300 BEEP .1,RND *30
310 PLOT 26+i *10,30;z$(i)
320 NEXT i
330 FOR y=1 TO 50
340 ROLL 7
350 NEXT y
360 FOR i=1 TO 5
370 BEEP .1,RND *30
380 PLOT 21,140-i *16;" *"
390 NEXT i
400 FOR i=1 TO 18
410 BEEP .1,RND *30
420 PLOT 21+i *10,60;" *"
430 >NEXT i
440 FOR i=1 TO 4
450 BEEP .1,RND *30
460 PLOT 202,60+i *16;" *"
470 NEXT i
480 FOR i=1 TO 17
490 BEEP .1,RND *30
500 PLOT 202-i *10,124;" *"
510 NEXT i
520 PLOT 18,125: DRAW 0,
    -82
530 DRAW 195,0: DRAW 0,82
540 DRAW -195,0
550 FOR x=1 TO 12
560 ROLL 8
570 NEXT x
580 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
590 BEEP .4,19: BEEP .2,23
600 BEEP .4,28: BEEP .2,26
```

```
610 BEEP .4,24 :  BEEP .2,23
620 BEEP .4,21 :  BEEP .2,23
630 BEEP .4,24 :  BEEP .2,26
640 >BEEP .4,23 : BEEP .2,21
650 BEEP .2,21 :  BEEP .2,19
660 BEEP .2,23 :  BEEP .4,26
670 BEEP .2,26
680 FOR i=1 TO 175 : SCROLL
    7 : NEXT i
690 PAUSE 100 : CLS
700 FOR i=1 TO 5
710 FOR x=1 TO (50+i *40)
    STEP 5
720 LET y=160-150/(50+i *
    40)^2 *x^2
730 LET y1=160-150/(50+i *
    40)^2 * (x+5)^2
740 PLOT x,y : DRAW 5,y1-y
750 NEXT x : NEXT i
760 PRINT #0 ; "TRAIECTO-
    RIILE SINT ARCE DE
    PARABOLA"
770 PAUSE 0 : CLS
780 PRINT AT 1,5 ; "FOLO-
    SIND ACEST PROGRAM
    PUTETI AFLA :"
790 >PRINT AT 4,5 ; "-timpul
    de coborire (tc)"
800 PRINT AT 5,5 ; "-distanta
    parcursa pe orizontala (d)"
810 PRINT AT 7,5 ; "-viteza
    finala (v')"
820 PAUSE 0 : CLS
830 CSIZE 0
840 PRINT AT 0,1 ; "INALTI-
    MEA DE LA CARE SE
    ARUNCA"
850 INPUT "Introduceti !" ;
    LINE h$
860 FOR i=1 TO LEN h$
870 IF CODE h$(i)< 45 OR
    CODE h$(i) >57 THEN GO
    TO 850
880 IF CODE h$(i)=47 THEN
    GO TO 850
890 NEXT i
900 LET h=VAL h$
910 PRINT AT 2,10 ; "h=" ;
    h ;"m"
920 >PRINT AT 3,0 ; "===
    ==========="
930 PRINT AT 4,7 ; "VITEZA
    INITIALA"
940 INPUT "Introduceti !" ;
    LINE v$
950 FOR i=1 TO LEN v$
960 IF CODE v$(i)< 46 OR
    CODE v$(i) >57 THEN GO
    TO 940
970 IF CODE v$(i)=47 THEN
    GO TO 940
980 NEXT i
990 LET vo=VAL v$
1000 PRINT AT 6,10 ; "vo=" ;
     vo ;"m/s"
1010 PRINT AT 7,0 ; "====
     ========"
1020 PRINT AT 8,6 ; "TIMPUL
     DE COBORIRE"
1030 PRINT AT 10,10 ; "tc=" ;
     SQR (2 *h/9.8) ;"s"
1040 >PRINT AT 11,0 "---
     --------"
1050 PRINT AT 12,0 ; "DISTAN
     TA PARCURSA PE ORI
     ZONTALA"
1060 PRINT AT 14,10 ; "d=" ;
     vo *SQR (2 *h/9.8) ; ,,m"
1070 PRINT AT 15,0 ; "---
     -------"
1080 PRINT AT 16,7 ; "VITEZA
     FINALA"
1090 PRINT AT 18,10 ; "v'=" ;
     SQR (vo^2+2 *9.8 *h) ;
     "m/s"
```

```
1100 PRINT AT 19,0; "---
     ---------"
1110 PAUSE 0: CLS
1120 GO TO 840
1130 SAVE "Orizontala" LINE
     10
```

1.5. MIŞCAREA CIRCULARĂ UNIFORMĂ („CIRCULARA")

Caracterele şi blank-urile din şirul „MIŞCAREA CIRCULARĂ UNIFORMĂ" se aranjează în mod uniform pe circumferinţa unui cerc. Apoi se face o prezentare a mărimilor fizice ce caracterizează această mişcare (raza, viteza, frecvenţa, viteza unghiulară, acceleraţia centripetă), pentru ca în final să se ceară determinarea acestora pentru o mişcare circulară uniformă simulată. Numărul de rotaţii se fixează de către utilizator.

În acest program au fost generate caracterele niu, omega şi pi. Pentru a dezactiva afişarea în Beta 3.1 s-a folosit instrucţiunea KEYWORDS 0.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="MISCAREA
    CIRCULARA UNIFORMA"
130 FOR i=1 TO 28
140 BEEP .1,RND *30
150 PLOT 120-64 *COS
    (2 *PI/28 *i),100+64 *
    SIN (2 *PI/28 *i) ;a$(i)
160 NEXT i
170 PAUSE 50
180 FOR i=1 TO 16
190 >BEEP .1,RND *30
200 PLOT 40+i *10,20 ;z$(i)
210 NEXT i
220 PAUSE 100
230 BEEP .4,19: BEEP .2,23
240 BEEP .4,28: BEEP .2,26
250 BEEP .4,24: BEEP .2,23
260 BEEP .4,21: BEEP .2,23
270 BEEP .4,24: BEEP .2,26
280 BEEP .4,23: BEEP .2,21
290 BEEP .2,21: BEEP .2,19
300 BEEP .2,23: BEEP .4,26
310 BEEP .2,26
320 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
330 PAUSE 100
340 CSIZE 0: CLS
350 DEF PROC vector
360 DRAW 8,0: DRAW -3,-2
370 DRAW 0,4: DRAW 3,-2
380 END PROC
390 DEF PROC sud
400 >DRAW 2,5: DRAW -4,0
```

```
410 DRAW 2,-5
420 END PROC
430 DEF PROC est
440 DRAW -5,-2: DRAW
    0,4
450 DRAW 5,-2
460 END PROC
470 DEF PROC nord
480 DRAW -2,-5: DRAW 4,0
490 DRAW -2,5
500 END PROC
510 DEF PROC vest
520 DRAW 5,-2: DRAW 0,4
530 DRAW -5,-2
540 END PROC
550 FOR u=0 TO 2*PI STEP
    .02
560 PLOT 70+50*COSE(u),
    110+50*SINE(u)
570 NEXT u
580 PAUSE 100
590 PLOT 70,110
600 DRAW 49,0: PROC est
610>PLOT 90, 105: PROC
    vector
620 PLOT 90,102; "r"
630 PAUSE 50
640 PLOT 70, 110
650 DRAW 0,49: PROC nord
660 PLOT 75,135: PROC vector
670 PLOT 75,132; "r"
680 PAUSE 50
690 PLOT 70,110
700 DRAW -49,0: PROC vest
710 PLOT 40,122: PROC vector
720 PLOT 40,119; "r"
730 PAUSE 50
740 PLOT 70,110: DRAW 0,
    -49
750 PROC sud
760 PLOT 58,90: PROC vector
770 PLOT 58,87; "r"
780 PAUSE 100
790 PLOT 130,172: PROC vec-
    tor
800 LET a$="r-raza vectoare"
810 LET x=130: LET y=169
820 GO SUB 2350
830>PAUSE 100
840 PLOT 120,110
850 DRAW 0,40: PROC nord
860 PLOT 122,135: PROC vec-
    tor
870 PLOT 122,132; "v"
880 PAUSE 50
890 PLOT 70,160
900 DRAW -40,0: PROC vest
910 PLOT 45,172: PROC vector
920 PLOT 45,169; "v"
930 PAUSE 50
940 PLOT 20,110
950 DRAW 0,-40: PROC sud
960 PLOT 5,95: PROC vector
970 PLOT 5,92; "v"
980 PAUSE 50
990 PLOT 70,60
1000 DRAW 40,0: PROC est
1010 PLOT 90,57: PROC vector
1020 PLOT 90,54; "v"
1030 PAUSE 100
1040 PLOT 150,152: PROC vec-
     tor
1050>LET a$="v-viteza"
1060 LET x=150: LET y=149
1070 GO SUB 2350
1080 PAUSE 200
1090 LET a$="PERIOADA
     MISCARII CIRCULARE"
1100 LET y=40: GO SUB 2400
1110 LET a$="UNIFORME
     ESTE INTERVALUL DE
     TIMP"
1120 LET y=30: GO SUB 2400
1130 LET a$="IN CARE MO-
     BILUL PARCURGE"
1140 LET y=20: GO SUB 2400
```

```
1150 LET a$="CIRCUMFERIN
     TA CERCULUI."
1160 LET y=10: GO SUB 2400
1170 PRINT AT 4,16; " "; AT
     5,16;" "
1180 FOR i=0 TO 15
1190 FOR j=0 TO 15
1200 PRINT AT i,j; " "
1210 NEXT j: NEXT i
1220>PAUSE 100
1230 FOR u=0 TO 2 *PI STEP
     .02
1240 PLOT 70+50 *COSE(u),
     110+50 *SINE(u)
1250 NEXT u
1260 PAUSE 100: LET a$=
     "T-perioada"
1270 LET x=150: LET y=130
1280 GO SUB 2350
1290 PAUSE 0: GO SUB 2450
1300 LET a$="FRECVENTA
     DE ROTATIE REPRE-
     ZINTA"
1310 LET y=40: GO SUB 2400
1320 LET a$="NUMARUL DE
     ROTATII EFECTUATE"
1330 LET y=30: GO SUB 2400
1340 LET a$="IN UNITATEA
     DE TIMP."
1350 LET Y=20: GO SUB 2400
1360 PAUSE 200
1370 KEYWORDS 0
1380 LET i=USR "n"
1390>POKE i+0,BIN 00000000
1400 POKE i+1,BIN 00000000
1410 POKE i+2,BIN 00000100
1420 POKE i+3,BIN 00100010
1430 POKE i+4,BIN 00010010
1440 POKE i+5,BIN 00001010
1450 POKE i+6,BIN 00001100
1460 POKE i+7,BIN 00000000
1470 PLOT 150,108; "ON
     ERROR"
1480 LET a$="—frecventa"
1490 LET x=160: LET y=108
1500 GO SUB 2350
1510 PAUSE 0: GO SUB 2450
1520 LET a$="VITEZA UN-
     GHIULARA REPREZIN-
     TA"
1530 LET y=40: GO SUB 2400
1540 LET a$="UNGHIUL LA
     CENTRU DESCRIS"
1550 LET y=30: GO SUB 2400
1560 LET a$="DE RAZA VEC-
     TOARE IN UNITATEA"
1570 LET y=20: GO SUB 2400
1580>LET a$="DE TIMP."
1590 LET y=10: GO SUB 2400
1600 PAUSE 200
1610 FOR u=0 TO PI/3 STEP
     .005
1620 PLOT 70,110
1630 DRAW 49 *COSE(u),49 *
     SINE(u)
1640 NEXT u
1650 PAUSE 100
1660 LET i=USR "o"
1670 POKE i+0,BIN 00000000
1680 POKE i+1,BIN 00000000
1690 POKE i+2,BIN 00100100
1700 POKE i+3,BIN 01000010
1710 POKE i+4,BIN 01000010
1720 POKE i+5,BIN 01011010
1730 POKE i+6,BIN 00100100
1740 POKE i+7,BIN 00000000
1750 PLOT 150,90: PROC vector
1760 PLOT 150,87; "ON"
1770 LET a$="—viteza"
1780 LET x=160: LET y=88
1790 GO SUB 2350
1800>LET a$="unghiulara"
1810 LET x=170: LET y=80
1820 GO SUB 2350
1830 PAUSE 0: GO SUB 2450
1840 LET a$="DEOARECE
     VECTORUL VITEZA
     VARIAZA"
```

```
1850 LET y=40: GO SUB 2400
1860 LET a$="CA DIRECTIE,
     EXISTA O ACCELERA-
     TIE"
1870 LET y=30: GO SUB 2400
1880 LET a$="ORIENTATA
     SPRE CENTRUL CERCU-
     LUI,"
1890 LET y= 20: GO SUB 2400
1900 LET a$="NUMITA
     ACCELERATIE
     CENTRIPETA."
1910 LET y=10: GO SUB 2400
1920 PAUSE 200
1930 PLOT 70,160
1940 DRAW -40,0: PROC vest
1950 PLOT 45,172: PROC vector
1960 PLOT 45,169; "v": PAUSE
     100
1970 PLOT 70,160: DRAW 0,
-40
1980 >PROC sud
1990 PLOT 50, 140: PROC vector
2000 PLOT 50,137; "a": PLOT
     58,13 2; "n"
2010 PAUSE 100
2020 PLOT 130,60: PROC vector
2030 PLOT 130,57; "a": PLOT
     138,5 2; "n"
2040 LET a$="-acceleratia"
2050 LET x=150: LET y=57
2060 GO SUB 2350
2070 LET a$="normala"
2080 LET x=190: LET y=50
2090 GO SUB 2350
2100 PAUSE 0: GO SUB 2450
2110 LET a$="RETINETI
     URMATOARELE
     RELATII:"
2120 LET y=40: GO SUB 2400
2130 PLOT 10,20: "T"
2140 PLOT 20,20; "ON ERROR"
2150 PLOT 30,20; "=1; v="
2160 PLOT 80,16: DRAW 25,0
2170 >PLOT 110,20; ";"
2180 LET i=USR "p"
2190 POKE i+0,BIN 00000000
2200 POKE i+1,BIN 00000001
2210 POKE i+2,BIN 00111110
2220 POKE i+3,BIN 01010010
2230 POKE i+4,BIN 00010010
2240 POKE i+5,BIN 00010010
2250 POKE i+6,BIN 00010010
2260 POKE i+7,BIN 00000000
2270 PLOT 80,25; "2 DPOKE
     r": PLOT 90,14; "T"
2280 PLOT 130,20; "v=r":
     PLOT 155,20; "ON"
2290 PLOT 164,20; ";"
2300 PLOT 180,20; "a": PLOT
     190,16; "n"
2310 PLOT; 200,20"=": PLOT
     210,20; "ON"
2320 PLOT 220,24; "2": PLOT
     230,20; "r"
2330 PAUSE 0: CLS
2340 >GO TO 2500
2350 FOR i=1 TO LEN a$
2360 BEEP .1,RND *30
2370 PLOT x-8+i *8,y ;a$(i)
2380 NEXT i
2390 RETURN
2400 FOR i=1 TO LEN a$
2410 BEEP .05,RND *30
2420 PLOT 127.5-4 *LEN a$
     +8 *i-8,y;a$(i)
2430 NEXT i
2440 RETURN
2450 FOR i=17 TO 21
2460 FOR j=0 TO 31
2470 PRINT AT i,j; " "
2480 NEXT j: NEXT i
2490 RETURN
2500 PRINT #0; "SA SE AFLE
     PERIOADA SI FRECVEN-
     TA DE ROTATIE!"
2510 PAUSE 0
```

```
2520 GO SUB 2660
2530 >INPUT "DORITI RELU-
     AREA MISCARII?(d/n)";
     s$
2540 IF s$="d" OR s$<>"n"
     THEN GO TO 2520
2550 CLS
2560 PRINT #0;"SA SE AFLE
     RAZA, VITEZA LINIARA
     SI VITEZA UNGHIULA-
     RA!"
2570 PAUSE 0
2580 GO SUB 2660
2590 INPUT "DORITI RELUA-
     REA MISCARII?(d/n)";t$
2600 IF t$="d" OR t$<>"n"
     THEN GO TO 2550
2610 CLS
2620 PRINT #0;"SA SE AFLE
     ACCELERATIA NORMA-
     LA, TANGENTIALA SI
     TOTALA!"
2630 PAUSE 0
2640 GO SUB 2660
2650 PAUSE 0: STOP
2660 >CLS
2670 INPUT "Cite rotatii com-
     plete doriti sa se execute?";
     LINE n$
2680 FOR i=1 TO LEN n$
2690 IF CODE n$(i)<46 OR
     CODE n$(i)>57 THEN GO
     TO 2670
2700 IF CODE n$(i)=47 THEN
     GO TO 2670
2710 NEXT i
2720 LET n=VAL n$
2730 PRINT AT 21,25;"n=";
     n;"rot"
2740 POKE 23673,0: POKE
     23672,0
2750 FOR i=1 TO 27*n STEP
     .4
2760 LET x=120-60*COSE
     ((2*PI/27*i))
2770 LET y=100+60*SINE
     ((2*PI/27*i))
2780 PLOT x,y;"*"
2790 PAUSE 6
2800 PLOT OVER 1;x,y;"*"
2810 >PRINT AT 21,0;"t=";
     USING "00.0";(256*
     PEEK 23673+PEEK
     23672)/50;"secunde"
2820 NEXT i
2830 RETURN
2840 SAVE "Circulara" LINE 10
```

1.6. DETERMINAREA CONSTANTEI DE ELASTICITATE A UNUI RESORT („RESORT")

În partea stîngă a ecranului un resort ideal netensionat este folosit ca martor, iar în apropierea acestuia apare unul identic dar tensionat. Tensionarea se produce după ce utilizatorul introduce valoarea greutății folosite pentru întindere. Se măsoară alungirea cu ajutorul unei rigle, apoi instrucțiunea INPUT cere introducerea ei. Atît greutatea folosită, cît și alungirea măsurată, sînt tipărite într-un tabel în care pe ultima coloană apare și constanta de elasticitate, calculată la valori întregi. Atenție la unități!

După efectuarea unui număr de 10 determinări se calculează media constantei de elasticitate.

Se poate constata că programul a fost în așa fel realizat încît alungirile resortului să nu ducă la modificarea numărului de spire, ci numai la modificarea pasului în funcție de greutatea folosită pentru alungire.

```
10 >BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT AT 3,5;"READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 DEF PROC a
130 FOR i=1 TO LEN a$
140 BEEP .1,RND *30
150 PLOT 127.5-4 *LEN a$+
    8 *i-8,y ;a$(i)
160 NEXT i
170 END PROC
180 LET a$="DETERMINA-
    REA CONSTANTEI",
    y=133
190 PROC a
200 >LET a$="DE ELASTI-
    CITATE A UNUI", y=113
210 PROC a
220 LET a$="RESORT",
    y=93
230 PROC a
240 PAUSE 50
250 LET a$=z$, y=60
260 PROC a
270 FOR i=1 TO 112
280 ROLL 5;100,95;7,20
290 NEXT i
300 PAUSE 50: PLOT 28,150
310 FOR i=1 TO 12
320 DRAW 0,-10,1.5 *PI
330 NEXT i
340 FOR i=1 TO 20
350 DRAW 10,0,1.5 *PI
360 NEXT i
370 FOR i=1 TO 12
380 DRAW 0,10,1.5 *PI
390 NEXT i
400 FOR i=1 TO 20
410 >DRAW -10,0,1.5 *PI
420 NEXT i
430 PAUSE 100
440 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
450 BEEP .4,19: BEEP .2,23
460 BEEP .4,28: BEEP .2,26
470 BEEP .4,24: BEEP .2,23
480 BEEP .4,21: BEEP .2,23
490 BEEP .4,24: BEEP .2,26
500 BEEP .4,23: BEEP .2,21
510 BEEP .2,21: BEEP .2,19
520 BEEP .2,23: BEEP .4,26
530 BEEP .2,26
540 PAUSE 100
550 FOR i=1 TO 175: SCROLL
    7: NEXT i
560 PLOT 10,170: DRAW 60,0
570 FOR x=10 TO 70 STEP 5
580 PLOT x,170: DRAW 5,5
590 NEXT x
600 PLOT 20,170: DRAW 0,
    -10
610 >FOR n=1 TO 14
620 DRAW 0,-5,-1.6 *PI
630 NEXT n
640 DRAW 0,-10: PLOT 10,
    80
650 DRAW 20,0
660 PLOT 82,170: DRAW 0,
    -110
670 DRAW 168,0: DRAW 0,110
```

```
680 DRAW -168,0
690 PLOT 82,150: DRAW 168,0
700 PLOT 114, 170: DRAW 0,
    -110
710 PLOT 154,170: DRAW 0,
    -110
720 PLOT 194,170: DRAW 0,
    -110
730 PLOT 250,170: DRAW 0,
    -110
740 PLOT 94,168;"n"
750 PLOT 120,168;"G[N]"
760 PLOT 160,168;"y[m]"
770 PLOT 200,168; "k[N/m]"
780 CSIZE 0
790 DIM m(10)
800 FOR n=1 TO 10
810 PRINT AT 3+n,12;n
820 >INPUT "Introduceti greu-
    tatea!"; LINE g$
830 FOR i=1 TO LEN g$
840 IF CODE g$(i)<46 OR
    CODE g$(i)>57 THEN GO
    TO 820
850 IF CODE g$(i)=47 THEN
    GO TO 820
860 NEXT i
870 LET g=VAL g$
880 IF g<10 OR g>70 THEN
    PRINT AT 21,0;" Greuta-
    tea apartine [10,70] N"
890 IF g<10 OR g>70 THEN
    GO TO 820
900 PRINT AT 21,0; " "
910 PRINT AT 3+n,15;g
920 PLOT 60,170: DRAW 0,
    -10
930 FOR i=1 TO 14
940 DRAW 0, -5-1/14*g,-
    (1.5-.002*g)*PI
950 NEXT i
960 >DRAW 0,80-g-PEEK
    23678
970 DRAW-10,0: DRAW 0,
    -10
980 DRAW 20,0: DRAW 0,10
990 DRAW-10,0
1000 PLOT 40,80: DRAW -2,
     -5
1010 DRAW 4,0: DRAW -2,5
1020 PLOT 40,80: DRAW 0,-g
1030 DRAW -2,5: DRAW 4,0:
     DRAW -2,-5
1040 PLOT 45,84-g/2; "y"
1050 INPUT "Masurati alungi-
     rea!"; LINE y$
1060 FOR i=1 TO LEN y$
1070 IF CODE y$(i)<46 OR
     CODE y$(i)>57 THEN GO
     TO 1050
1080 IF CODE y$(i)=47 THEN
     GO TO 1050
1090 NEXT i
1100 LET y=VAL y$
1110 PRINT AT 3+n,20;y
1120 LET m(n) = g/y
1130 >PRINT AT 3+n,26;INT
     (.5+g/y)
1140 FOR i=1 TO 21
1150 PRINT AT i,4; " "
1160 NEXT i
1170 NEXT n
1180 LET s=0
1190 FOR n=1 TO 10
1200 LET s=s+m(n)
1210 NEXT n
1220 CSIZE 8,16
1230 PRINT AT 8,1; "Valoarea
     medie a constantei de"
1240 PRINT AT 9,7; "elastici-
     tate este:"
1250 PRINT AT 10,7; "km=";
     s/10;"N/m"
1260 PAUSE 0: CLS
1270 GO TO 560
1280 SAVE "Resort" LINE 10
```

1.7. CIOCNIREA UNIDIMENSIONALĂ PERFECT ELASTICĂ („CIOCUPEL")

Introducînd masele a două corpuri şi vitezele lor înainte de ciocnire, calculatorul tipăreşte valorile vitezelor după ciocnire, precum şi nişte săgeţi a căror lungime este proporţională cu viteza.

Acest program este util pentru a analiza cazurile particulare de ciocnire unidimensională perfect elastică, cum ar fi: ciocnirea a două corpuri de mase egale care schimbă vitezele între ele, ciocnirea cu un perete etc. În cazul ciocnirii cu un perete, masa corpului care ciocneşte fiind neglijabilă, se va introduce valoarea zero.

Dacă vitezele corpurilor sînt orientate în sensul pozitiv al axei (deci spre dreapta), se vor introduce fără semn; în caz contrar vitezele vor fi introduse cu semnul minus.

Dacă condiţia de ciocnire nu este îndeplinită, apare mesajul: „Ciocnirea nu se produce!", iar dacă una din mase are valoarea negativă, apare mesajul: „Nu are sens fizic!". Mesajul „Reveniţi în mecanica clasică" vă invită să lucraţi cu viteze mici în comparaţie cu viteza luminii în vid.

```
10 PAPER 6: BORDER 2
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="CIOCNIREA"
130 LET b$="UNIDIMENSI-
    ONALA"
140 LET c$="PERFECT
    ELASTICA"
150 FOR i=1 TO 9
160 BEEP .1,20
170 PLOT 75+10*i,130;a$(i)
180 PAUSE 5
190 NEXT i
200 FOR i=1 TO 15
210 BEEP .1,20
220>PLOT 45+i*10,110;b$(i)
230 PAUSE 5
240 NEXT i
250 FOR i=1 TO 16
260 BEEP .1,20
270 PLOT 40+i*10,90;c$(i)
280 PAUSE 5
290 NEXT i
300 PAUSE 100
310 FOR i=1 TO 16
320 BEEP .1,RND*30
330 PLOT 40+i*10,70;z$(i)
340 NEXT i: PAUSE 100
350 FOR i=1 TO 7
```

```
360 BEEP .1,RND *30
370 PLOT 30,164-i *16; " *"
380 NEXT i
390 FOR i=1 TO 19
400 BEEP .1,RND *30
410 PLOT 30+i *10,50; " *"
420 NEXT i
430 FOR i=1 TO 7
440>BEEP .1,RND *30
450 PLOT 220,36+i *16;" *"
460 NEXT i
470 FOR i=1 TO 18
480 BEEP .1,RND *30
490 PLOT 220-i *10,150;" *"
500 NEXT i
510 PLOT 27,155: DRAW 0,
    -130
520 DRAW 205,0: DRAW 0,130
530 DRAW -205,0
540 PAUSE 100
550 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
560 BEEP .4,19: BEEP .2,23
570 BEEP .4,28: BEEP .2,26
580 BEEP .4,24: BEEP .2,23
590 BEEP .4,21: BEEP .2,23
600 BEEP .4,24: BEEP .2,26
610 BEEP .4,23: BEEP .2,21
620 BEEP .2,21: BEEP .2,19
630 BEEP .2,23: BEEP .4,26
640 BEEP .2,26
650>PAUSE 100
660 FOR i=1 TO 175
670 SCROLL 7
680 NEXT i
690 PRINT AT 2,5; "Vitezele
    dupa ciocnire :"
700 PLOT 44,80; "v1=2-vo1"
710 PLOT 76,71: DRAW 103,0
720 PLOT 76,88; "m1.vo1+m2.
    vo2"
730 PLOT 108,70; "m1+m2"
740 PLOT 44,40; "v2=2-vo2"
750 PLOT 76,31: DRAW 103,0
760 PLOT 76,48; "m1.vo1+m2.
    vo2"
770 PLOT 108,30; "m1+m2"
780 PAUSE 0: CLS
790 PRINT AT 1,2; "Notati pe
    tabla și apoi analizati ur-
    matoarele cazuri :"
800 PRINT
810>PRINT TAB 4; "1)m1
    >m2;vo1>0; vo2=0"
820 PRINT TAB 4; "2)m1=
    m2; vo1>0; vo2=0"
830 PRINT TAB 4; "3)m1<
    m2;vo1>0;vo2=0"
840 PRINT TAB 4; "4)m1=0;
    m2>0;vo1>0;vo2=0"
850 PRINT TAB 4; "5)m1>0;
    m2=0;vo1>0;vo2=0"
860 PRINT TAB 4; "6)m1>0;
    m2>0; vo1<vo2"
870 PAUSE 0: CLS
880 PRINT AT 0,5; "INAINTE
    DE CIOCNIRE"
890 INPUT "Introduceti m1 in
    kg"; LINE m$
900 FOR i=1 TO LEN m$
910 IF CODE m$(i)<45 OR
    CODE m$ (i)>57 THEN
    GO TO 890
920 IF CODE m$(i)=47 THEN
    GO TO 890
930>NEXT i
940 LET m1=VAL m$
950 PRINT AT 1,4;"m1=";
    m1; "kg"
960 PAUSE 50
970 CIRCLE 65,125,4
980 INPUT "Introduceti m2
    in kg"; LINE m$
990 FOR i=1 TO LEN m$
1000 IF CODE m$(i)<45 OR
     CODE m$(i)>57 THEN
     GO TO 980
```

```
1010 IF CODE m$(i)=47 THEN
     GO TO 980
1020 NEXT i
1030 LET m2=VAL m$
1040 PRINT AT 1,20; "m2=";
     m2;"kg"
1050 PAUSE 50
1060 CIRCLE 195,125,4
1070 IF m1<0 OR m2<0
     THEN PRINT #0;
     FLASH 1; "Nu are sens
     fizic!"
1080 IF m1<0 OR m2<0
     THEN PAUSE 0
1090>IF m1<0 OR m2<0
     THEN RUN 880
1100 INPUT "Introduceti vo1 in
     m/s"; LINE v$
1110 FOR i=1 TO LEN v$
1120 IF CODE v$(i)<45 OR
     CODE v$(i)>57 THEN
     GO TO 1100
1130 IF CODE v$(i)=47 THEN
     GO TO 1100
1140 NEXT i
1150 LET vo1=VAL v$
1160 PRINT AT 4,0;"vo1=";
     vo1; "m/s"
1170 INPUT "Introduceti vo2 in
     m/s"; LINE v$
1180 FOR i=1 TO LEN v$
1190 IF CODE v$(i)<45 OR
     CODE v$(i)>57 THEN
     GO TO 1170
1200 IF CODE v$(i)=47
     THEN GO TO 1170
1210 NEXT i
1220 LET vo2=VAL v$
1230>PRINT AT 4,16; "vo2=";
     vo2; "m/s"
1240 IF vo1>=1e8 OR vo2>
     =1e8 THEN PRINT #0;
     FLASH 1; "Reveniti in
     mecanica clasica!"
1250 IF vo1>=1e8 OR vo2>=
     1e8 THEN PAUSE 0
1260 IF vo1>=1e8 OR vo2>=
     1e8 THEN RUN 880
1270 IF vo1<=vo2 THEN
     PRINT #0; FLASH 1;"
     Ciocnirea nu se produce!"
1280 IF vo1<=vo2 THEN
     PAUSE 0
1290 IF vo1<=vo2 THEN RUN
     880
1300 FOR i=0 TO 32 STEP 2
1310 BEEP .1,RND*30
1320 PRINT AT 5,i;"-"
1330 NEXT i
1340 PAUSE 50
1350 PRINT AT 6,9;"DUPA
     CIOCNIRE"
1360 PAUSE 50
1370>PRINT AT 7,4; "m1=";
     m1; "kg"
1380 PAUSE 50
1390 CIRCLE 65,35,4
1400 PAUSE 50
1410 PRINT AT 7,20; "m2= ";
     m2; "kg"
1420 PAUSE 50
1430 CIRCLE 195,35,4
1440 PAUSE 50
1450 LET v1=2*(m1*vo1+m2
     *vo2)/(m1+m2)-vo1
1460 LET v2=2*(m1*vo1+
     m2*vo2)/(m1+m2)-
     vo2
1470 PRINT AT 10,0; "v1=";
     INT (v1*1000)/1000;
     "m/s"
1480 PRINT AT 10,16;"v2=";
     INT (v2*1000)/1000;"m/s"
1490 LET d01=0: LET d02=0:
     LET d1=0: LET d2=0
1500 IF ABS vo1>=ABS vo2
     AND ABS vo1>=v1 AND
```

```
      ABS vo1 >=ABS v2
      THEN LET d01=55
1510 >IF d01=55 THEN LET
      d02=55 *ABS vo2/ABSvo1
1520 IF d01=55 THEN LET
      d1=55 *ABS v1/ABS vo1
1530 IF d01=55 THEN LET
      d2=55 *ABS v2/ABSvo1
1540 IF ABS vo2 >=ABS vo1
      AND ABS vo2 >=ABS v1
      AND ABS vo2 >=ABS
      v2 THEN LET d02=55
1550 IF d02=55THEN LET
      d01=55 *ABS vo1/ABS
      vo2
1560 IF d02=55 THEN LET
      d1=55 *ABS v1/ABS vo2
1570 IF d02=55 THEN LET
      d2=55 *ABS v2/ABS vo2
1580 IF ABS v1 >=ABS vo1
      AND ABS v1 >=ABS vo2
      AND ABS v1>=ABS v2
      THEN LET d1=55
1590 IF d1=55 THEN LET
      d01=55 *ABS vo1/ABS
      v1
1600 IF d1=55 TEHN LET
      d02=55 *ABS vo2/ABS v1
1610 >IF d1=55 THEN LET
      d2=55 *ABS v2/ABS v1
1620 IF ABS v2 >=ABS vo1
      AND ABS v2 >=ABS vo2
      AND ABS v2 >=ABS v1
      THEN LET d2=55
1630 IF d2=55 THEN LET
      d01=55 *ABS vo1/ABS v2
1640 IF d2=55 THEN LET
      d02=55 *ABS vo2/ABS v2
1650 IF d2=55 THEN LET
      d1=55 *ABS v1/ABS v2
1660 IF vo1 >0 THEN GO SUB
      1750
1670 IF vo1 <0 THEN GO SUB
      1770
1680 IF vo2 >0 THEN GO SUB
      1790
1690 IF vo2 <0 THEN GO SUB
      1810
1700 IF v1 >0 THEN GO SUB
      1830
1710 IF v1 <0 THEN GO SUB
      1870
1720 IF v2 >0 THEN GO SUB
      1910
1730 IF v2 <0 THEN GO SUB
      1950
1740 PAUSE 0 : RUN 880
1750 >PLOT 70,125 : DRAW
      d01,0 : DRAW -5,2 :
      DRAW 0,-4 : DRAW 5,2
1760 RETURN
1770 PLOT 60,125 : DRAW
      -d01,0 : DRAW 5,-2 :
      DRAW 0,4 : DRAW -5,
      -2
1780 RETURN
1790 PLOT 200,125 : DRAW
      d02,0 : DRAW -5,2 :
      DRAW 0,-4 : DRAW 5,2
1800 RETURN
1810 PLOT 190,125 :
      DRAW -d02,0 : DRAW
      5,-2 : DRAW 0,4 : DRAW
      -5,-2
1820 RETURN
1830 PLOT 70,35 : DRAW d1,0
1840 DRAW -5,2 : DRAW
      0,-4
1850 DRAW 5,2
1860 RETURN
1870 PLOT 60,35 : DRAW
      -d1,0
1880 DRAW 5, -2: DRAW 0, 4
1890 > DRAW -5, -2
1900 RETURN
1910 PLOT 200, 35: DRAW d2,0
1920 DRAW -5,2: DRAW 0,-4
```

```
1930 DRAW 5,2
1940 RETURN
1950 PLOT 190, 35: DRAW —d
     2,0
1960 DRAW 5, —2: DRAW 0,4
1970 DRAW —5, —2
1980 RETURN
1990 SAVE "Ciocupel" LINE 10
```

1.8. MIŞCAREA OSCILATORIE ARMONICĂ („OSCILAŢIE")

După o prezentare a ecuaţiilor elongaţiei, vitezei şi acceleraţiei, este simulată mişcarea oscilatorie armonică, reprezentîndu-se simultan graficul dependenţei elongaţiei de timp.

Pentru o mişcare oscilatorie armonică simulată se cer o serie de mărimi fizice cum ar fi: frecvenţa, perioada, amplitudinea, viteza maximă, acceleraţia maximă etc. Utilizatorul introduce numărul de oscilaţii ce doreşte a fi executate, iar calculatorul afişează timpul scurs pentru executarea acestor oscilaţii. Pentru măsurarea unor distanţe (a amplitudinii), elevii vor folosi o riglă.

La un anumit nivel, asteriscul nu este şters pentru a se putea observa că în apropierea poziţiei de echilibru distanţele sînt mai mari, scăzînd pe măsura apropierii de extremităţile cursei.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 FOR t=0 TO 2 STEP.05
130 PLOT 5,87+87*SINE
    ((PI*t)); "MISCAREA"
140 PAUSE 5
150 PLOT OVER 1;5,87+87*
    SINE((PI*t)); "MISCA-
    REA"
160 NEXT t
170 BEEP .02,40
180 PLOT 5,87; "MISCAREA"
190 PAUSE 100
200 >FOR t=0 TO 2 STEP
    .05
210 PLOT 80,87+87*SINE
    ((PI*t)); "OSCILATO-
    RIE"
220 PAUSE 5
230 PLOT OVER 1; 80,87+87*
    SINE((PI*t)); "OSCILA-
    TORIE"
240 NEXT t
250 BEEP .02,40
260 PLOT 80,87; "OSCILATO-
    RIE"
270 PAUSE 100
280 FOR t=0 TO 2 STEP .05
290 PLOT 180,87+87*SINE
    ((PI*t)); "ARMONICA"
300 PAUSE 5
310 PLOT OVER 1;180,87+
```

```
    87 * SINE((PI * t)) ; "AR-
    MONICA"
320 NEXT t
330 BEEP .02,40
340 PLOT 180,87 ; "ARMO-
    NICA"
350 PAUSE 50
360 FOR i=1 TO 16
370 BEEP .1,RND *30
380 >PLOT 40+i * 10,60 ;
    z$(i)
390 NEXT i
400 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
410 PAUSE 100
420 BEEP .4,19 : BEEP .2,23
430 BEEP .4,28 : BEEP .2,26
440 BEEP .4,24 : BEEP .2,23
450 BEEP .4,21 : BEEP .2,23
460 BEEP .4,24 : BEEP .2,26
470 BEEP .4,23 : BEEP .2,21
480 BEEP .2,21 : BEEP .2,19
490 BEEP .2,23 : BEEP .4,26
500 BEEP .2,26
510 PAUSE 100
520 FOR i=1 TO 175
530 SCROLL 7
540 NEXT i
550 KEYWORDS 0
560 LET i=USR "o"
570 POKE i+0,BIN 00000000
580 POKE i+1,BIN 00000000
590 >POKE i+2,BIN 00100100
600 POKE i+3,BIN 01000010
610 POKE i+4,BIN 01000010
620 POKE i+5,BIN 01011010
630 POKE i+6,BIN 00100100
640 POKE i+7,BIN 00000000
650 PRINT AT 1,5 ; "Ecuatiile
    oscilatorului"
660 PRINT AT 3,8 ; "liniar ar-
    armonic :"
670 PRINT AT 5,11 ; "y=A.
    sin ON t"
680 PRINT AT 7,11 ; "v=ON
    A.cos ON t"
690 PRINT AT 9,11 ; "a=-
    ON .A.s in ON t"
700 PLOT 120,38 ;"2"
710 DEF PROC sun
720 FOR i=1 TO 4
730 BEEP .3,30 : BEEP .2,35 :
    BEEP .1,40
740 NEXT i
750 >END PROC
760 PAUSE 0
770 CLS
780 PLOT 20,20 : DRAW 0,
    155
790 DRAW 2,-5 : DRAW -4,0
800 DRAW 2,5
810 PAUSE 100
820 PLOT FLASH 1 ;6,175 ; "y"
830 PROC sun
840 PLOT FLASH 0 ;6,175 ;
    "y"
850 PAUSE 100
860 PLOT 20,80 : DRAW 235,0
870 DRAW -5,2 : DRAW 0,-4
880 DRAW 5,2
890 PAUSE 100
900 PLOT FLASH 1 ;224,75 ;
    "t(s)"
910 PROC sun
920 PLOT FLASH 0 ;224,75 ;
    "t(s)"
930 PAUSE 100
940 PRINT FLASH 1 ;
    AT 0,12 ; "y=A.sin ON t"
950 PROC sun
960 >PRINT FLASH 0 ;AT
    0,12 ; "y=A. sin ON t"
970 PAUSE 0
980 POKE 23672,0 : POKE
    23673,0
990 FOR t=0 TO 199
```

```
1000 LET y1=80+50 *SINE
     (PI/20 *(t+1))
1010 PLOT 6,y1+9; "*"
1020 LET y=80+50 *SINE
     (PI/20 *t)
1030 PLOT 20+t,y
1040 DRAW 1,y1-y
1050 PRINT AT 4,26; USING
     "00.0"; (PEEK 23672+
     256 *PEEK 23673)/50
1060 PAUSE 5
1070 PLOT OVER 1;6,y1+9;
     "*"
1080 NEXT t
1090 PLOT 6,89; "*"
1100 INPUT "Doriti reluarea?
     (d/n)"; s$
1110 IF s$="d" OR s$<>"n"
     THEN GO TO 770
1120>PRINT AT 10,0; "Deter-
     minati amplitudinea!"
1130 PAUSE 0
1140 PRINT AT 10,0; "Deter-
     minati perioada!"
1150 PAUSE 0
1160 PRINT AT 10,0; "Deter-
     minati frecventa!"
1170 PAUSE 0
1180 PRINT AT 10,0; "Deter-
     minaţi pulsatia!"
1190 PAUSE 0
1200 PRINT AT 10,0; "Deter-
     minati viteza maxima!"
1210 PAUSE 0
1220 PRINT AT 10,0; "Determi-
     nati acceleratia maxima!"
1230 PAUSE 0: CLS
1240 PRINT AT 0,2; "Aflati
     perioada, frecventa şi pulsa-
     tia miscarii oscilatorii!"
1250>INPUT "Cite oscilaţii do-
     riţi?"; LINE n$
1260 FOR i=1 TO LEN n$
1270 IF CODE n$(i)<46 OR
     CODE n$(i)>57 THEN GO
     TO 1250
1280 IF CODE n$(i)=47 THEN
     GO TO 1250
1290 NEXT i
1300 LET n=VAL n$
1310 PRINT AT 8,17; "n=";
     n;" oscilatii"
1320 GO SUB 1470
1330 INPUT "Reluam misca-
     rea?(d/n)";a$
1340 IF a$="d" OR a$<>"n"
     THEN RUN 1240
1350 CLS
1360 PRINT AT 0,3; "Aflati am-
     plitudinea, viteza maxima
     şi acceleratia maxima!"
1370 INPUT "Cite oscilatii do-
     riti?"; LINE n$
1380>FOR i=1 TO LEN n$
1390 IF CODE n$(i)<46 OR
     CODE n$(i)>57 THEN
     GO TO 1370
1400 IF CODE n$(i)=47 THEN
     GO TO 1370
1410 NEXT i
1420 LET n=VAL n$
1430 PRINT AT 8,17; "n=";n;"
     oscilatii"
1440 GO SUB 1470
1450 PAUSE 0
1460 STOP
1470 POKE 23672,0: POKE
     23673,0
1480 FOR t=0 TO 2*n STEP
     .1
1490 PLOT 127+119 *SINE
     ((PI *t-PI/2)), 120; "*"
1500 PLOT 127+119 *SINE
     ((PI *t-PI/2)), 100; "*"
1510 PLOT OVER 1; 127+119 *
     SINE((PI *t-PI/2)), 100;
     "*"
```

```
1520 >PRINT AT 8,0 ; "t=" ;
     USING "00.0" ; (PEEK
     23672+256 *PEEK 23673)
     /50 ; "secunde ;"
1530 NEXT t
1540 RETURN
1550 SAVE "Oscilatie" LINE
     10
```

1.9. COMPUNEREA OSCÎLAȚIILOR PARALELE („COPA")

În manualele de clasa a IX-a, compunerea oscilațiilor paralele este tratată numai analitic. Tratarea grafică realizată cu ajutorul calculatorului contribuie la o mai bună înțelegere a acestei lecții.

Sînt analizate cazuri particulare de compunere a oscilațiilor paralele aflate în fază, în opoziție de fază, în cvadratur1.

Ultimul exemplu depășește puțin nivelul manualului, referindu-se la compunerea a două oscilații de frecvențe apropiate, adică la fenomenul bătăilor.

Pentru a mării viteza de execuție a graficelor s-a folosit funcția predefinită SINE, din Beta 3.1.

```
10 BORDER 2 : PAPER 6
20 INK 1 : CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1 ; AT
   3,5 ; "READY"
100 PAUSE 0 : BORDER 4
110 CLS
120 CSIZE 8,16
130 PLOT 0,50 ; "Program :"
140 FOR x=0 TO 70
150 PLOT x,130 ; "COMPUNE-
    REA"
160 NEXT x
170 FOR y=116 TO 50 STEP
    -1
180 PLOT 70,y ;"C"
190 NEXT y
200 BEEP .08,30
210 FOR x=0 TO 78
220 >PLOT x, 110 ; "OSCILA-
    TIILOR"
230 NEXT x
240 FOR y=94 TO 50 STEP
    -1
250 PLOT 78,y ;"0"
260 NEXT y
270 BEEP .08,30
280 FOR x=0 TO 86
290 PLOT x,90 ;"PARALELE"
300 NEXT x
310 FOR y=76 TO 50 STEP
    -1
320 PLOT 86,y ; "PA"
330 NEXT y
340 BEEP .08,30
350 PAUSE 100
360 PLOT 96,25 ;z$
370 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
380 PAUSE 100
```

```
390 BEEP .4,19: BEEP .2,23
400 BEEP .4,28: BEEP .2,26
410 BEEP .4,24: BEEP .2,23
420 BEEP .4,21: BEEP .2,23
430>BEEP .4,24: BEEP .2,26
440 BEEP .4,23: BEEP .2,21
450 BEEP .2,21: BEEP .2,19
460 BEEP .2,23: BEEP .4,26
470 BEEP .2,26
480 PAUSE 100
490 FOR i=1 TO 175
500 SCROLL 7
510 NEXT i
520 CLS
530 KEYWORDS 0
540 LET i=USR "o"
550 POKE i+0,BIN 00000000
560 POKE i+1,BIN 00000000
570 POKE i+2,BIN 00100100
580 POKE i+3,BIN 01000010
590 POKE i+4,BIN 01000010
600 POKE i+5,BIN 01011010
610 POKE i+6,BIN 00100100
620 POKE i+7,BIN 00000000
630 LET i=USR "f"
640 POKE i+0,BIN 00000000
650>POKE i+1,BIN 00001100
660 POKE i+2,BIN 01010010
670 POKE i+3,BIN 01010010
680 POKE i+4,BIN 01010010
690 POKE i+5,BIN 00111100
700 POKE i+6,BIN 00010000
710 POKE i+7,BIN 00010000
720 LET i=USR "p"
730 POKE i+0,BIN 00000000
740 POKE i+1,BIN 00000001
750 POKE i+2,BIN 00111110
760 POKE i+3,BIN 01010010
770 POKE i+4,BIN 00010010
780 POKE i+5,BIN 00010010
790 POKE i+6,BIN 00010010
800 POKE i+7,BIN 00000000
810 PRINT TAB 8; "y1=a1.
    sin(ONt+FILL 1)"
820 PRINT TAB 15; FLASH 1;
    "+"
830 PRINT TAB 8; "y2=a2.
    sin(ONt+FILL 2)"
840 PRINT TAB 15; FLASH
    1; "="
850>PRINT TAB 9; "y=a.
    sin(ON t + FILL)"
860 PRINT " . . . . . . .
    . . . . . . ."
870 PRINT AT 7,0; "Unde:
    a=a1+a2+2.a1a2cos
    (FILL 2-FILL 1)"
880 PLOT 48,70; "2"
890 PLOT 80,70; "2"
900 PLOT 112,70; "2"
910 PRINT AT 9,2; "tg
    (FILL)="
920 PLOT 68,20: DRAW
    136,0
930 PLOT 68,36; "a1.sin FILL
    1+a2.sin FILL 2"
940 PLOT 68,19; "a1.cos FILL
    1+a2.cos FILL 2"
950 PAUSE 0: CLS
960 PRINT AT 3,10; "Daca
    FILL 2-FILL 1=0"
970 PRINT AT 5,4; "oscila-
    tiile sint în faza"
980 PRINT AT 7,11; "=>
    a=a1+a2"
990>PAUSE 0: CLS
1000 PRINT #0; "OSCILATII
     DE AMPLITUDINI DI-
     FERITE, FRECVENTE
     EGALE, FAZE EGALE"
1010 PRINT FLASH 1; AT 3,15;
     "+"; AT 5,15; "="
1020 LET a1=15, a2=10, t1=10,
     t2=10, f=0
1030 GO SUB 1460
1040 PRINT FLASH 0; AT
     3,15; "+"; AT 5,15; "="
1050 PAUSE 0: CLS
```

```
1060 PRINT AT 2,10; ,,Daca
     FILL 2-FILL 1 =
     DPOKE"
1070 PRINT AT 4,8; "oscila-
     tiile sint"
1080 PRINT AT 6,6; "in opo-
     zitie de faza"
1090 PRINT AT 8,11; "=>
     a=a1-a2"
1100 PAUSE 0: CLS
1110>PRINT #0;"OSCILATII
     DE AMPLITUDINI DI-
     FERITE, FRECVENTE
     EGALE, OPOZITIE DE
     FAZA"
1120 PRINT FLASH 1;AT 3,15;
     "+"; AT 6,15: "="
1130 LET f=-PI
1140 GO SUB 1460
1150 PRINT FLASH 0; AT
     3,15; "+";AT 6,15; "="
1160 PAUSE 0: CLS
1170 PRINT #0;"OSCILATII
     DE AMPLITUDINI
     EGALE, FRECVENTE E-
     GALE, OPOZITIE DE
     FAZA"
1180 PRINT FLASH 1; AT
     3,15;"+";AT 6,15; "="
1190 LET a2=15
1200 GO SUB 1460
1210 PRINT FLASH 0; AT
     3,15; "+";AT 6,15;"="
1220 PAUSE 0: CLS
1230>PRINT AT 2,9; "Daca
     FILL 2-FILL 1=
     DPOKE/2"
1240 PRINT AT 4,8; "oscila-
     latiile sint"
1250 PRINT AT 6,10; "in cvad-
     ratura"
1260 PRINT AT 8,10; "=>a=
     a1+a2"
1270 PLOT 112,55;"2"
1280 PLOT 144,55;"2"
1290 PLOT 178,55;"2"
1300 PAUSE 0: CLS
1310 PRINT #0; "OSCILATII
     DE AMPLITUDINI DI-
     FERITE, FRECVENTE
     EGALE, IN CVADRAT-
     URA"
1320 PRINT FLASH 1; AT
     3,16; "+"
1330 PRINT FLASH 1; AT
     6,16; "="
1340 LET a2=10, f=-PI/2
1350 GO SUB 1460
1360 PRINT FLASH 0; AT
     3,16;"+";AT 6,16;"="
1370 PAUSE 0: CLS
1380>PRINT AT 5,7; "FENO-
     MENUL BATAILOR"
1390 PAUSE 0: CLS
1400 PRINT #0; "OSCILATII
     DE AMPLITUDINI DIFE-
     RITE, FRECVENTE
     APROPIATE"
1410 PRINT FLASH 1; AT
     3,15; "+"; AT 6,15; "="
1420 LET f=0, t2=13
1430 GO SUB 1460
1440 PRINT FLASH 0; AT
     3,15; "+";AT 6,15; "="
1450 PAUSE 0: STOP
1460 FOR x=40 TO 215
1470 LET y=150+a1*SINE
     ((x/t1*PI))
1480 LET y1=150+a1*SINE
     (((x+1)/t1*PI))
1490 LET z=100+a2*SINE
     ((x/t2*PI+f))
1500 LET z1=100+a2*SINE
     (((x+1)/t2*PI+f))
1510>PLOT x,y: DRAW 1,
     y1-y
```

```
1520 PLOT x,z: DRAW 1,z1—z
1530 PLOT x,y+z—200: DRAW
     1,y1+z1—y—z
1540 NEXT x
1550 RETURN
1560 SAVE "Copa" LINE 10
```

1.10. OSCILAȚII AMORTIZATE („AMORTIZATE")

Șirul „OSCILAȚII AMORTIZATE" execută în generic o mișcare oscilatorie amortizată, după care este dată expresia matematică care descrie oscilația armonică amortizată și semnificația fizică a mărimilor. În timp ce asteriscul descrie o mișcare armonică amortizată în lungul axei OY, se reprezintă graficul $y = f(t)$, în cazul căruia este știut că amplitudinea scade exponențial cu timpul.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="OSCILATII
    AMORTIZATE"
130 FOR i=1 TO 20
140 BEEP .1—i*.005,40—i
150 LET a=77*EXP(—.17*i)
160 PLOT 10+10*i,87;a$(i)
170 ROLL 7,a: PAUSE 10
180 ROLL 6,2*a: PAUSE 10
190 ROLL 7,a
200 NEXT i
210>PAUSE 50
220 FOR i=1 TO LEN z$
230 BEEP .1,RND*30
240 PLOT 28+i*10,60;z$(i)
250 NEXT i
260 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
270 PAUSE 100
280 BEEP .4,19: BEEP .2,23
290 BEEP .4,28: BEEP .2,26
300 BEEP .4,24: BEEP .2,23
310 BEEP .4,21: BEEP .2,23
320 BEEP .4,24: BEEP .2,26
330 BEEP .4,23: BEEP .2,21
340 BEEP .2,21: BEEP .2,19
350 BEEP .2,23: BEEP .4,26
360 BEEP .2,26
370 PAUSE 100
380 FOR i=1 TO 175
390 SCROLL 7
400 NEXT i
410>LET c$="IN CAZUL
    OSCILATIILOR"
420 FOR i=1 TO 21
430 BEEP .1,RND*30
440 PLOT 10+i*10,130; c$(i)
450 NEXT i
460 LET d$="AMORTIZATE,
    AMPLITUDINEA"
470 FOR i=1 TO 23
480 BEEP .1,RND*30
```

```
490 PLOT i * 10,110 ;d$(i)
500 NEXT i
510 LET e$="SCADE EXPO-
NENTIAL CU"
520 FOR i=1 TO 20
530 BEEP .1,RND *30
540 PLOT 10+10 *i, 90 ;e$(i)
550 NEXT i
560 DEF PROC sun
570 FOR i=1 TO 3
580 BEEP .2,30 : BEEP .2,35 :
BEEP .2,40
590 >NEXT i
600 END PROC
610 LET f$="TIMPUL"
620 FOR i=1 TO 6
630 BEEP .1,RND *30
640 PLOT 80+i * 10,70 ; f$(i)
650 NEXT i
660 PAUSE 100 : CLS
670 KEYWORDS 0
680 LET i=USR "a"
690 POKE i+0,BIN 00000000
700 POKE i+1,BIN 00000010
710 POKE i+2,BIN 00110100
720 POKE i+3,BIN 01001000
730 POKE i+4,BIN 01001000
740 POKE i+5,BIN 01001000
750 POKE i+6,BIN 00110110
760 POKE i+7,BIN 00000000
770 LET i=USR "p"
780 POKE i+0,BIN 00000000
790 POKE i+1,BIN 00000001
800 POKE i+2,BIN 00111110
810 >POKE i+3,BIN 01010010
820 POKE i+4,BIN 00010010
830 POKE i+5,BIN 00010010
840 POKE i+6,BIN 00010010
850 POKE i+7,BIN 00000000
860 PRINT TAB 2 ; "Oscila-
tia armonica amortizata"
870 PRINT TAB 4 ; "este des-
crisa de ecuatia :"
880 PLOT 50,120 ; "y=A.e
.cos(2 DPOKE/T)t"
890 PLOT 90,128 ; "-ALTER
t"
900 PLOT 42,133 : DRAW 0,
-35
910 DRAW 170,0 : DRAW
0,35
920 DRAW -170,0
930 PRINT AT 6,0 ; "Unde :
A=amplitudinea inițiala"
940 PRINT TAB 5 ; "e=2,71
. . . . . . "
950 PRINT TAB 5 ; "ALTER
=factorul de amortizare"
960 >PRINT TAB 5 ; "T=
perioada oscilațiilor"
970 PRINT TAB 5;."t=timpul"
980 PAUSE 0 : CLS
990 PLOT 20,0 : DRAW 0,175
1000 DRAW 2,-5 : DRAW
-4,0
1010 DRAW 2,5
1020 PAUSE 100
1030 PLOT FLASH 1 ;5,175 ;
"y"
1040 PROC sun
1050 PLOT FLASH 0 ;5,175 ;
"y"
1060 PAUSE 100
1070 PLOT 20,80 : DRAW 235,0
1080 DRAW -5,2 : DRAW
0,-4
1090 DRAW 5,2
1100 PAUSE 100
1110 PLOT FLASH 1 ;245,75 ;
"t"
1120 PROC sun
1130 PLOT FLASH 0 ;245,75 ;
"t"
1140 PAUSE 100
1150 PRINT #0 ; "GRAFICUL
OSCILATIILOR AMOR-
TIZATE"
```

```
1160>PAUSE 100
1170 FOR t=0 TO 230
1180 LET y1=80+70 *EXP
  (-.017 *(t+1)) *COS ((t+
  1)/15 *PI)
1190 PLOT 6,y1+9; " * "
1200 LET y=80+70 *EXP
  (-.017 *t) *COS (t/15 *PI)
1210 PLOT 20+t,y : DRAW 1,
  y1-y
1220 PAUSE 5
1230 PLOT OVER 1;6,y1+9;
  " * "
1240 NEXT t
1250 PLOT 6,89; " * "
1260 PAUSE 0: STOP
1270 SAVE "Amortizate" LINE
  10
```

2. FENOMENE TERMICE

2.1. AGITAȚIA TERMICĂ („AGITAȚIE")

După un dans aleator al caracterelor, acestea se ordonează formînd șirul „AGITAȚIA TERMICĂ".

Cu ajutorul funcției predefinite RND, sînt puse în evidență traiectoriile rectilinii ale unei molecule de gaz, în prima parte a programului pentru o temperatură mai scăzută, apoi pentru o temperatură mai ridicată, cînd intensitatea agitației termice crește.

În reprezentarea traiectoriilor rectilinii ale unei molecule, au fost folosite adresele 23677 și 23678 La prima adresă se găsește abscisa ultimului punct plot-at, iar la a doua ordonata ultimului punct plot-at.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="AGITATIA"
130 FOR i=1 TO 8
140 FOR n=1 TO 5
150 LET x=INT (RND *247),
    y=16+INT (RND *159)
160 PLOT OVER 1;x,y;a$(i)
170 BEEP .05,30: PAUSE 20
180 PLOT OVER 1;x,y;a$(i)
190 NEXT n
200 PLOT 35+i *20,120;a$(i)
210 >NEXT i
220 LET b$="TERMICA"
230 FOR i=1 TO 7
240 FOR n=1 TO 5
250 LET x=INT (RND *247),
    y=16+INT (RND *159)
260 PLOT OVER 1;x,y;b$(i)
270 BEEP .05,30
280 PAUSE 20
290 PLOT OVER 1;x,y;b$(i)
300 NEXT n
310 PLOT 40+i *20,100;b$(i)
320 NEXT i
```

```
330 PAUSE 100
340 FOR i=1 TO LEN z$
350 BEEP .1,RND *30
360 PLOT 40+i *10,80 ;z$(i)
370 NEXT i
380 PAUSE 50
390 FOR i=1 TO 6
400 BEEP .1,RND *30
410 PLOT 40,156-i *16; " *"
420 >NEXT i
430 FOR i=1 TO 17
440 BEEP .1,RND *30
450 PLOT 40+i *10,60 ;" *"
460 NEXT i
470 FOR i=1 TO 5
480 BEEP .1,RND *30
490 PLOT 210,60+i *16; " *"
500 NEXT i
510 FOR i=1 TO 16
520 BEEP .1,RND *30
530 PLOT 210-i *10,140 ; " *"
540 NEXT i
550 PAUSE 50: PLOT 38,142
560 DRAW 0,-100: DRAW
    182,0
570 DRAW 0,100: DRAW
    -182,0
580 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
590 PAUSE 100
600 BEEP .4,19: BEEP .2,23
610 BEEP .4,28: BEEP .2,26
620 BEEP .4,24: BEEP .2,23
630 >BEEP .4,21: BEEP .2,23
640 BEEP .4,24: BEEP .2,26
650 BEEP .4,23: BEEP .2,21
660 BEEP .2,21: BEEP .2,19
670 BEEP .2,23: BEEP .4,26
680 BEEP .2,26
690 PAUSE 100
700 FOR i=1 TO 175
710 SCROLL 7
720 NEXT i
730 LET a$="MOLECULELE
    ORICARUI CORP,"
740 FOR i=1 TO 25
750 BEEP .1,RND *30
760 PLOT 17+i *8,150 ;a$(i)
770 NEXT i
780 LET b$="INDIFERENT
    DE STAREA LUI DE"
790 FOR i=1 TO 27
800 BEEP .1,RND *30
810 PLOT 7+i *8,130 ;b$(i)
820 NEXT i
830 >LET c$="AGREGARE,
    SE AFLA INTR-O"
840 FOR i=1 TO 23
850 BEEP .1,RND *30
860 PLOT 27+i *8,110 ;c$(i)
870 NEXT i
880 LET d$="MISCARE PER-
    MANENTA, DEZORDO-
    NATA,"
890 FOR i=1 TO 31
900 BEEP .1,RND *30
910 PLOT i*8-3,90 ;d$(i) :
    NEXT i
920 LET e$="NUMITA MIS-
    CARE TERMICA"
930 FOR i=1 TO 22
940 BEEP .1,RND *30
950 PLOT 37+i *8,70 ;e$(i)
960 NEXT i
970 LET f$="(SAU AGITA-
    TIE TERMICA)"
980 FOR i=1 TO 22
990 BEEP .1,RND *30
1000 PLOT 27+i *8,50 ;f$(i)
1010 >NEXT i
1020 PAUSE 0: CLS
1030 LET d=20: GO SUB 1230
1040 PAUSE 0: CLS
1050 LET a$="INTENSITA-
    TEA AGITATIEI TERMI-
    CE"
1060 FOR i=1 TO 30
```

```
1070 BEEP .1,RND *30
1080 PLOT 2+i *8,130 ;a$(i)
1090 NEXT i
1100 LET b$="CRESTE ODA-
     TA CU CRESTEREA"
1110 FOR i=1 TO 25
1120 BEEP .1,RND *30
1130 PLOT 17+i *8,100 ;b$(i)
1140 NEXT i
1150 LET c$="TEMPERATU-
     RII."
1160 FOR i=1 TO 13
1170 BEEP .1,RND *30
1180 PLOT 57+i *8,70 ;c$(i)
1190 NEXT i
1200 PAUSE 0: CLS
1210 >LET d=5: GO SUB 1230
1220 PAUSE 0: STOP
1230 PLOT INT (RND *255),
     INT (RND *175)
1240 FOR i=1 TO 40
1250 BEEP .05,30
1260 DRAW INT (RND *255)
     -PEEK 236 77,INT
     (RND * 175)-PEEK 23678
1270 PAUSE d
1280 NEXT i
1290 RETURN
1300 SAVE "Agitatie" LINE 10
```

2.2. LEGEA BOYLE-MARIOTTE („BOYLE")

Se tipărește enunțul legii, expresia ei matematică și semnificația fizică a mărimilor care intervin în ea, apoi se reprezintă grafic izoterma (arcul de hiperbolă).

```
 10 BORDER 2: PAPER 6
 20 INK 1: CLS
 30 DIM z$(16)
 40 FOR i=1 TO 16
 50 READ d
 60 LET z$(i)=CHR$ d
 70 NEXT i
 80 CSIZE 16,24
 90 PRINT FLASH 1 ;AT 3,5;
    "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="LEGEA"
130 FOR i=1 TO 5
140 BEEP .1,RND *30
150 PLOT 65+i *20,120 ;a$(i)
160 NEXT i
170 LET b$="BOYLE—
    MARIOTTE"
180 FOR i=1 TO 14
190 BEEP .1,RND *30
200 PLOT 50+i *10,100 ;b$(i)
210 NEXT i
220 >PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND *30
250 PLOT 40+i *10,80 ;z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND *30
300 PLOT 40,156-i *16;" *"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND *30
340 PLOT 40+i *10,60 ;" *"
350 NEXT i
360 FOR i=1 TO 5
```

```
370 BEEP .1,RND *30
380 PLOT 210,60+i * 16;"*"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210-i *10,140;" * "
430 NEXT i
440 >PAUSE 50: PLOT 38,142
450 DRAW 0,-100: DRAW
    182,0
460 DRAW 0,100: DRAW
    -182,0
470 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
480 PAUSE 100
490 BEEP .4,19: BEEP .2,23
500 BEEP .4,28: BEEP .2,26
510 BEEP .4,24: BEEP .2,23
520 BEEP .4,21: BEEP .2,23
530 BEEP .4,24: BEEP .2,26
540 BEEP .4,23: BEEP .2,21
550 BEEP .2,21: BEEP .2,19
560 BEEP .2,23: BEEP .4,26
570 BEEP .2,26
580 PAUSE 100
590 FOR i=1 TO 175
600 SCROLL 7
610 NEXT i
620 DEF PROC sir
630 FOR i=1 TO LEN a$
640 BEEP .05,RND *35
650 >PLOT 127.5-4 *LEN a$
    +8 *i-8,y;a$(i)
660 NEXT i
670 END PROC
680 LET a$="Legea BOYLE
    -MARIOTTE",y=150
690 PROC sir
700 LET a$="sau",y=130
710 PROC sir
720 LET a$="legea transfor-
    marii izoterme.",y=110
730 PROC sir
740 LET a$="t=constant",
    y=70
750 PROC sir
760 LET a$="m=constant",
    y=50
770 PROC sir
780 PAUSE 0: CLS
790 LET a$="Enuntul legii
    BOYLE-MARIOTTE:",
    y=170
800 PROC sir
810 LET a$="Presiunea unui
    gaz aflat la",y=130
820 >PROC sir
830 LET a$="temperatura con-
    stanta variaza", y=110
840 PROC sir
850 LET a$="invers proporti-
    onal cu volumul",y=90
860 PROC sir
870 LET a$="gazului.",y=70
880 PROC sir
890 PAUSE 0: CLS
900 LET a$="Expresia mate-
    matica a legii",y=160
910 PROC sir
920 LET a$="BOYLE-
    MARIOTTE",y=130
930 PROC sir
940 LET a$="-------",
    y=100
950 PROC sir
960 LET a$="p.V=constant",
    y=80
970 PROC sir
980 LET a$="-------",
    y=60
990 PROC sir
1000 >PAUSE 0: CLS
1010 PLOT 10,10: DRAW 200,0
1020 DRAW -5,3: DRAW 0,-6
1030 DRAW 5,3
1040 PLOT 20,0: DRAW 0,160
```

```
1050 DRAW -3,-5: DRAW
     6,0: DRAW -3,5
1060 PAUSE 100
1070 DEF PROC sun
1080 FOR i=1 TO 3
1090 BEEP .2,30: BEEP .2,35:
     BEEP .2,40
1100 NEXT i
1110 END PROC
1120 PRINT FLASH 1;AT 0,1;
     "p"
1130 PROC sun
1140 PRINT FLASH 0;AT 0,1;
     "p"
1150 PAUSE 100
1160 PRINT AT 10,1; "O"
1170 PAUSE 100
1180 PRINT AT 5,17; "p=f(V)"
1190 PAUSE 100
1200>PRINT FLASH 1;AT
     9,26;"V"
1210 PROC sun
1220 PRINT FLASH 0;AT 9,26;
     "V"
1230 PAUSE 100
1240 FOR x=30 TO 205 STEP .2
1250 PLOT x,4800/x
1260 NEXT x
1270 PRINT AT 1,15; "Izoter-
     ma"
1280 PRINT AT 2,8; "(hiper-
     bola echilatera)"
1290 PAUSE 0: STOP
1300 SAVE "BOYLE" LINE 10
```

2.3. LEGEA GAY-LUSSAC („GAY")

Sînt date toate formulările din manual ale legii Gay—Lussac, expresiile lor matematice, semnificația fizică a mărimilor, apoi reprezentările grafice pentru $V=f(t)$ și $V=f(T)$.

În cazul acestui program fiind necesară generarea caracterului alfa, s-a folosit instrucțiunea KEYWORDS 0, care a dezactivat afișarea în Beta 3.1.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="LEGEA"
130 FOR i=1 TO 5
140 BEEP .1,RND*30
150 PLOT 65+i*20,120;a$(i)
160 NEXT i
170 LET b$="GAY-
    LUSSAC"
180 FOR i=1 TO 10
190 BEEP .1,RND*30
200 PLOT 70+i*10,100;b$(i)
210 NEXT i
220>PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND*30
250 PLOT 40+i*10,80;z$(i)
260 NEXT i
```

```
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND *30
300 PLOT 40,156-i *16;" *"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND *30
340 PLOT 40+i *10,60;" *"
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND *30
380 PLOT 210,60+i *16;" *"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210-i *10,140;" *"
430 NEXT i
440>PAUSE 50: PLOT 38,142
450 DRAW 0, -100: DRAW
    182,0
460 DRAW 0,100: DRAW
    -182,0
470 PAUSE 100
480 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
490 BEEP .4,19: BEEP .2,23
500 BEEP .4,28: BEEP .2,26
510 BEEP .4,24: BEEP .2,23
520 BEEP .4,21: BEEP .2,23
530 BEEP .4,24: BEEP .2,26
540 BEEP .4,23: BEEP .2,21
550 BEEP .2,21: BEEP .2,19
560 BEEP .2,23: BEEP .4,26
570 BEEP .2,26
580 PAUSE 100: CLS
590 PRINT TAB 6; "Legea
    GAY-LUSSAC"
600 PRINT '
610 PRINT TAB 12; "sau"
620 PRINT '
630>PRINT TAB 2; "legea
    transformarii izobare"
640 PRINT '
650 PRINT TAB 9; "p=con-
    stant"
660 PRINT '
670 PRINT TAB 9; "m=con-
    stant"
680 PAUSE 0: CLS
690 KEYWORDS 0
700 LET i=USR "a"
710 POKE i+0,BIN 00000000
720 POKE i+1,BIN 00000010
730 POKE i+2,BIN 00110100
740 POKE i+3,BIN 01001000
750 POKE i+4,BIN 01001000
760 POKE i+5,BIN 01001000
770 POKE i+6,BIN 00110110
780 POKE i+7,BIN 00000000
790 PRINT '
800 CSIZE 0
810 PRINT TAB 3; "(1) Enun-
    tul legii GAY-LUSSAC:"
820 PRINT "
830>PRINT TAB 3; "Variatia
    relativa a volumului unui
    gaz, aflat la presiune con-
    stanta, este direct propor-
    tionala cu temperatura."
840 PRINT '
850 PRINT TAB 8; "----
    ----------"
860 PRINT TAB 8; "(V-Vo)/
    Vo=ALTER .t"
870 PRINT TAB 8; "----
    ----------"
880 PRINT '
890 PRINT "Unde:"
900 PRINT "V=volumul la
    temperatura t"
910 PRINT "Vo=volumul ga-
    zului la 0 grade C"
920 PRINT "ALTER=coefici-
    entul de dilatare izobara"
930 PRINT "ALTER=1/273,
    15 1/g rd"
940 PAUSE 0: CLS
```

```
950 CSIZE 8,16
960 >PRINT TAB 3 ; "(2)Enuntul legii GAY-LUSSAC:"
970 PRINT '
980 PRINT TAB 2 ; "Volumul unui gaz, aflat la presiune constanta, creste linear cu temperatura."
990 PRINT '
1000 PRINT TAB 8 ; "-------------"
1010 PRINT TAB 8; "V=Vo (1+ALTER t)"
1020 PRINT TAB 8 ; "-------------"
1030 PAUSE 0 : CLS
1040 PRINT TAB 2 ; "(3) Enuntul legii GAY-LUSSAC:"
1050 PRINT TAB 4; "Intr-o transformare izobara, volumul gazului, in orice stare, este direct proportional cu temperatura absoluta."
1060 PRINT TAB 10 ; "V=Vo. ALTER.T"
1070 >PRINT TAB 3 ; "Unde:"
1080 PRINT TAB 2 ; "T=temperatura absoluta"
1090 PRINT TAB 2; "T(K)= t(grdC)+273,15=t(grdC)+ To"
1100 PRINT TAB 3 ; "K=Kelvin"
1110 PAUSE 0 : CLS
1120 PRINT TAB 3 ; "(4) Enuntul legii GAY-LUSSAC:"
1130 PRINT '
1140 PRINT TAB 4 ; "Intr-o transformare izobara raportul dintre volum si temperatura absoluta in orice stare ramine constant."
1150 PRINT '
1160 PRINT TAB 8 ; "-------------"
1170 PRINT TAB 8; "V/T= constant"
1180 PRINT TAB 8 ; "-------------"
1190 PAUSE 0 : CLS
1200 PLOT 10,20 : DRAW 230,0
1210 >DRAW -5,-3 : DRAW 0,6 : DRAW 5,-3
1220 PLOT 100,10 : DRAW 0,150
1230 DRAW 3,-5 : DRAW -6,0 : DRAW 3,5
1240 PRINT AT 1,6 ;"V(m^3)"
1250 PRINT AT 1,16 ;"V=f(t)"
1260 PRINT AT 10,24 ;"t(grdC)"
1270 PRINT AT 10,14 ;"O"
1280 FOR x=30 TO 60 STEP 5
1290 PLOT x,13/19 *x
1300 NEXT x
1310 FOR x=60 TO 220
1320 PLOT x,13/19 *x
1330 NEXT x
1340 PRINT AT 6,9 ;"Vo"
1350 PRINT AT 10,0 ;"-273,15 grdC"
1360 PRINT AT 5,20 ; "Izobara"
1370 PRINT AT 6,19 ;"(dreapta)"
1380 PAUSE 0 : CLS
1390 PLOT 10,20 : DRAW 220, 0
1400 >DRAW -5,-3 : DRAW 0,6 : DRAW 5,-3
1410 PLOT 30,10 : DRAW 0,150
1420 DRAW 3,-5 : DRAW -6,0 : DRAW 3,5
1430 PRINT AT 1,5 ; "V(m^3)"
1440 PRINT AT 10,2 ; "O"
1450 PRINT AT 10,26 ; "T(K)"
1460 FOR x=30 TO 60 STEP 5
1470 PLOT x,13/19 *x
1480 NEXT x
```

```
1490 FOR x=60 TO 220
1500 PLOT x,13/19*x
1510 NEXT x
1520 PRINT AT 4,8; "V=f(T)"
1530 PRINT AT 6,19; "Izobara"
1540 PRINT AT 7,18; "(dreap-
     ta)"
1550 PAUSE 0: STOP
1560 SAVE "GAY" LINE 10
```

2.4. LEGEA LUI CHARLES („CHARLES")

Sînt date toate formulările din manual ale legii lui Charles, expresiile lor matematice, semnificația fizică a mărimilor, apoi reprezentările grafice pentru $p = f(t)$ și $p = f(T)$.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="LEGEA"
130 FOR i=1 TO 5
140 BEEP .1,RND*30
150 PLOT 65+i*20,120;a$(i)
160 NEXT i
170 LET b$="CHARLES"
180 FOR i=1 TO 7
190 BEEP .1,RND*30
200 PLOT 45+i*20,100;b$(i)
210 NEXT i
220>PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND*30
250 PLOT 40+i*10,80;z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND*30
300 PLOT 40,156-i*16;"*"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND*30
340 PLOT 40+i*10,60;"*"
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND*30
380 PLOT 210,60+i*16;"*"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND*30
420 PLOT 210-i*10,140;"*"
430 NEXT i
440>PAUSE 50
450 PLOT 38,142: DRAW 0,
    -100
460 DRAW 182,0: DRAW 0,
    100: DRAW -182,0
470 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
480 PAUSE 100
490 BEEP .4,19: BEEP .2,23
500 BEEP .4,28: BEEP .2,26
510 BEEP .4,24: BEEP .2,23
520 BEEP .4,21: BEEP .2,23
530 BEEP .4,24: BEEP .2,26
```

```
540 BEEP .4,23: BEEP .2,21
550 BEEP .2,21: BEEP .2,19
560 BEEP .2,23: BEEP .4,26
570 BEEP .2,26
580 PAUSE 100
590 FOR i=1 TO 175
600 SCROLL 7
610 NEXT i
620 CLS
630 PRINT '
640>PRINT TAB 9; "Legea
    CHARLES"
650 PRINT '
660 PRINT TAB 13; "sau"
670 PRINT '
680 PRINT TAB 2; "legea
    transformarii izocore"
690 PRINT '
700 PRINT TAB 10; "V=con-
    stant"
710 PRINT '
720 PRINT TAB 10; "m=con-
    stant"
730 PAUSE 0: CLS
740 KEYWORDS 0
750 LET i=USR "b"
760 POKE i+0,BIN 00000000
770 POKE i+1,BIN 00000000
780 POKE i+2,BIN 00011100
790 POKE i+3,BIN 00100010
800 POKE i+4,BIN 00101100
810 POKE i+5,BIN 00100010
820 POKE i+6,BIN 00111100
830 POKE i+7,BIN 00100000
840 CSIZE 0
850>PRINT '
860 PRINT TAB 3; "(1)Enun-
    tul legii CHARLES:"
870 PRINT ''
880 PRINT TAB 3; "Variatia
    relativa a presiunii unui gaz
    mentinut la volum constant
    este direct proportionala cu
    temperatura."
890 PRINT '
900 PRINT TAB 8; "————
    ——————————"
910 PRINT TAB 8; "(p—po)/
    po=BLANK .t"
920 PRINT TAB 8; "————
    —————————"
930 PRINT '
940 PRINT "Unde"
950 PRINT "p=presiunea gaz-
    lui la temperatura t"
960 PRINT "po=presiunea ga-
    zului la 0 grdC"
970 PRINT "BLANK=coefici-
    entul termic al presiunii"
980>PRINT "BLANK =1/
    273,15 1/grd"
990 PAUSE 0: CLS
1000 CSIZE 8,16
1010 PRINT TAB 3; "(2)Enun-
     tul legii CHARLES:"
1020 PRINT '
1030 PRINT TAB 5; "Presiunea
     unui gaz perfect mentinut
     la volum constant creste
     liniar cu temperatura."
1040 PRINT '
1050 PRINT TAB 10; "————
     ————————"
1060 PRINT TAB 10; "p=po
     (1+BLANK t)"
1070 PRINT TAB 10; "————
     ————————"
1080 PAUSE 0: CLS
1090 PRINT TAB 3; "(3)Enun-
     tul legii CHARLES:"
1100>PRINT TAB 4; "Intr-o
     transformare izocora, presi-
     unea gazului, in orice stare
     a sa, este direct proportio-
     nala cu temperatura abso-
     luta."
1110 PRINT '
```

```
1120 PRINT TAB 10; "p=
     BLANK .po. T"
1130 PRINT "Unde:"
1140 PRINT "T=temperatura
     absoluta"
1150 PRINT "T(K)=t(grdC)+
     273,15=t(grdC)+To"
1160 PRINT "K=Kelvin"
1170 PAUSE 0: CLS
1180 PRINT TAB 3; "(4)Enun-
     tul legii CHARLES:"
1190 PRINT '
1200>PRINT TAB 4; "Intr-o
     transformare izocora rapor-
     tul dintre presiune si tem-
     peratura absoluta in orice
     stare ramine constant."
1210 PRINT '
1220 PRINT TAB 7; "----
     ----------"
1230 PRINT TAB 7; "p/T=
     constant"
1240 PRINT TAB 7; "----
     ----------"
1250 PAUSE 0: CLS
1260 PLOT 10,20: DRAW 230,0
1270 DRAW -5,-3: DRAW
     0,6: DRAW 5,-3
1280 PLOT 100,10: DRAW 0,150
1290 DRAW 3,-5: DRAW
     -6,0: DRAW 3,5
1300 PRINT AT 1,3; "p(N/m^2)"
1310 PRINT AT 1,16; "p=f(t)"
1320 PRINT AT 10,25; "t(grdC)"
1330 PRINT AT 10,13;"O"
1340 FOR x=30 TO 60 STEP 5
1350 PLOT x,13/19*x
1360>NEXT x
1370 FOR x=60 TO 220
1380 PLOT x,13/19*x
1390 NEXT x
1400 PRINT AT 6,9;"po"
1410 PRINT AT 10,0;"-273,15
     grdC"
1420 PRINT AT 5,20; "Izocora"
1430 PRINT AT 6,19; "(dreap-
     ta)"
1440 PAUSE 0: CLS
1450 PLOT 10,20: DRAW 220,0
1460 DRAW -5,-3: DRAW
     0,6: DRAW 5,-3
1470 PLOT 30,10: DRAW 0,150
1480 DRAW 3,-5: DRAW
     -6,0: DRAW 3,5
1490 PRINT AT 1,5;"p(N/m^2)"
1500 PRINT AT 10,1;"O"
1510 PRINT AT 10,26;"T(K)"
1520 FOR x=30 TO 60 STEP 5
1530 PLOT x,13/19*x
1540 NEXT x
1550>FOR x=60 TO 220
1560 PLOT x,13/19*x
1570 NEXT x
1580 PRINT AT 4,8;"p=f(T)"
1590 PRINT AT 6,19; "Izocora"
1600 PRINT AT 7,18; "(dreap-
     ta)"
1610 PAUSE 0: STOP
1620 SAVE "CHARLES" LINE
     10
```

2.5. CICLUL CARNOT („CARNOT")

Simultan cu deplasarea pistonului în cilindru, se reprezintă grafic $p = f(V)$, obținîndu-se ciclul Carnot. Prin săgeți sînt reprezentate etapele în care se primește căldură de la sursa caldă, respectiv se cedează

căldură sursei reci. Lipsa săgeţilor indică desfăşurarea unui proces adiabatic.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="CICLUL"
130 FOR i=1 TO 6
140 BEEP .1,RND*30
150 PLOT 56+i*20,120;a$(i)
160 NEXT i
170 LET b$="CARNOT"
180 FOR i=1 TO 6
190 BEEP .1,RND*30
200 PLOT 56+i*20,100;b$(i)
210 NEXT i
220>PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND*30
250 PLOT 40+i*10,80;z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND*30
300 PLOT 40,156-i*16;"*"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND*30
340 PLOT 40+i*10,60;"*"
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND*30
380 PLOT 210,60+i*16;"*"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND*30
420 PLOT 210-i*10,140;"*"
430 NEXT i
440>PLOT 38,142: DRAW 0,
   -100
450 DRAW 182,0: DRAW
   0,100: DRAW -182,0
460 DATA 127,39,56,55,32,76,
   72,67,67,32,67,46,71,79,73,
   65
470 PAUSE 100
480 BEEP .4,19: BEEP .2,23
490 BEEP .4,28: BEEP .2,26
500 BEEP .4,24: BEEP .2,23
510 BEEP .4,21: BEEP .2,23
520 BEEP .4,24: BEEP .2,26
530 BEEP .4,23: BEEP .2,21
540 BEEP .2,21: BEEP .2,19
550 BEEP .2,23: BEEP .4,26
560 BEEP .2,26
570 PAUSE 100
580 FOR i=1 TO 175
590 SCROLL 7
600 NEXT i
610 IF CODE z$(13)< >71
   THEN NEW
620 CLS
630>DEF PROC sun
640 FOR i=1 TO 3
650 BEEP .2,30: BEEP .2,35:
   BEEP .2,40
660 NEXT i
670 END PROC
680 PLOT 30,50: DRAW 0,125
690 DRAW 2,-5: DRAW
   -4,0: DRAW 2,5
700 PAUSE 100
710 PLOT 15,60; "O"
720 PAUSE 100
```

```
730 PLOT FLASH 1;15,170;
    "p"
740 PROC sun
750 PLOT FLASH 0;15,170;
    "p"
760 PAUSE 100
770 PLOT 30,50: DRAW 225,0
780 DRAW -5,2: DRAW 0,
    -4: DRAW 5,2
790 PAUSE 100
800 PLOT FLASH 1;245,45;
    "V"
810 PROC sun
820>PLOT FLASH 0;245,45;
    "V"
830 PAUSE 100
840 PLOT 200,40: DRAW
    -171,0
850 DRAW 0,-30: DRAW
    170,0
860 PLOT 200,41: DRAW
    -171,0
870 DRAW 0,-32: DRAW
    171,0
880 PAUSE 100
890 PLOT 165,170; "CICLUL"
900 PLOT 185,155; "CARNOT"
910 PAUSE 100
920 PLOT 35,165; "1"
930 PAUSE 100
940 PLOT 10,40;"Q1"
950 PUSE 100
960 PLOT OVER 1;10,25:
    DRAW OVER 1; 30,0
970 DRAW OVER 1;-5,2:
    DRAW OVER1;0,-4:
    DRAW OVER 1;5,2
980 PAUSE 100
990 PLOT 10,20; "T1"
1000 PAUSE 0
1010 PLOT 50,39
1020 >DRAW 0,-28: DRAW
    8,0
1030 DRAW 0,28: DRAW -8,0
1040 FILL 55,30
1050 FOR x=50 TO 180
1060 ROLL 8;48,39;20,29
1070 IF x<140 THEN PLOT
    x,160*(50/x)^(LN (16/11)/
    LN (14/5))
1080 IF x=110 THEN GO SUB
    1630
1090 IF x=110 THEN GO SUB
    1660
1100 IF x=140 THEN PLOT
    145,120; "2"
1110 IF x>=140 THEN PLOT
    x,110*(140/x)^(LN (11/6)/
    LN(9/7))
1120 IF x=140 THEN PLOT
    OVER 1;10,40; "Q1"
1130 IF x=140 THEN PLOT
    OVER 1;10,20; "T1"
1140 IF x=140 THEN GO SUB
    1690
1150 IF x=140 THEN PLOT
    30,25
1160 IF x=160 THEN PLOT
    160,100; Q=0"
1170 NEXT x
1180 >PLOT 185,68; "3"
1190 PLOT 10,43; "Q2": PLOT
    OVER 1;40,25
1200 DRAW OVER 1;-30,0:
    DRAW OVER 1;5,2
1210 DRAW OVER 1;0,-4:
    DRAW OVER 1;-5,2
1220 PLOT 10,22; "T2"
1230 FOR x=180 TO 50 STEP
    -1
1240 SCROLL 5;48,39;20,29
1250 IF x>80 THEN PLOT
    x,60*(180/x)^(LN (3/5)
    /LN (4/9))
1260 IF x=130 THEN PLOT
    130,67; "T2"
1270 IF x=120 THEN GO SUB
    1750
```

```
1280 IF x=95 THEN PLOT
     95,75 ; "Q2"
1290 IF x=80 THEN PLOT
     OVER 1 ;10,43 ; "Q2"
1300 IF x=80 THEN PLOT
     OVER 1 ;10,22 ; "T2"
1310 IF x=80 THEN GO SUB
     1780
1320>IF x=80 THEN PLOT
     30,25
1330 IF x=80 THEN PLOT
     70,95 ; "4"
1340 IF x< =80 THEN PAUSE
     10
1350 IF x<=80 THEN PLOT
     x,8000/x
1360 IF x=60 THEN PLOT
     35,125 ; "Q=0"
1370 NEXT x
1380 PAUSE 0
1390 INPUT "Doriti reluarea ?
     (d/n)" ; s$
1400 IF s$<> "n" THEN GO
     TO 620
1410 CLS
1420 PRINT AT 0,2 ; "Randa-
     mentul masinii termice"
1430 PRINT AT 1,3 ; "care func-
     tioneaza după un"
1440 PRINT AT 2,7 ; "ciclu Car-
     not este :"
1450 KEYWORDS 0
1460 LET i=USR "e"
1470 POKE i+0,BIN 00000000
1480 POKE i+1,BIN 00000000
1490>POKE i+2,BIN 01011000
1500 POKE i+3,BIN 00100100
1510 POKE i+4,BIN 00100100
1520 POKE i+5,BIN 00100100
1530 POKE i+6,BIN 00000100
1540 POKE i+7,BIN 00000100
1550 PRINT AT 5,11 ; "ELSE
     =1-T2/T1"
1560 PLOT 80,100: DRAW 0,
     -30
1570 DRAW 88,0: DRAW 0,30
1580 DRAW -88,0
1590 PRINT AT 7,1 ; "unde :"
1600 PRINT AT 8,2 ; "T1-
     temperatura sursei calde"
1610 PRINT AT 9,2 ; "T2-tem-
     peratura sursei reci"
1620 PAUSE 0: STOP
1630 PLOT 110,150: DRAW 0,
     -40
1640 DRAW 2,5: DRAW -4,0:
     DRAW 2,-5
1650 RETURN
1660 PLOT 90,145 ; "Q1"
1670>PLOT 120,135 ; "T1"
1680 RETURN
1690 PLOT OVER 1 ;10,25
1700 DRAW OVER 1 ;30,0
1710 DRAW OVER 1 ;-5,2
1720 DRAW OVER 1 ;0,-4
1730 DRAW OVER 1 ;5,2
1740 RETURN
1750 PLOT 120,100: DRAW 0,
     -40
1760 DRAW 2,5: DRAW -4,0:
     DRAW 2,-5
1770 RETURN
1780 PLOT OVER 1 ;40,25
1790 DRAW OVER 1 ;-30,0
1800 DRAW OVER 1 ;5,2
1810 DRAW OVER 1 ;0,-4
1820 DRAW OVER 1 ;-5,2
1830 RETURN
1840 SAVE "CARNOT" LINE 10
```

2.6. MOTORUL OTTO („OTTO")

Într-un cilindru prevăzut cu o supapă de admisie, o supapă de evacuare și o bujie, se deplasează pistonul motorului. Simultan cu deplasarea pistonului se reprezintă grafic $p = f(V)$, adică ciclul după care funcționează motorul Otto. Instrucțiunea FLASH pune în evidență momentul în care între electrozii bujiei apare scînteia electrică necesară aprinderii amestecului carburant. Supapa de admisie se deschide în timpul admisiei, respectiv cea de evacuare în timpul evacuării gazelor.

În partea finală a programului se dă expresia randamentului, cu ajutorul căreia se pot rezolva probleme în care este dat exponentul adiabatic și raportul de compresie.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1; AT 3,5
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="MOTORUL"
130 FOR i=1 TO 7
140 BEEP .1,RND *30
150 PLOT 44+i *20,120;
    a$(i)
160 NEXT i
170 LET b$="OTTO"
180 FOR i=1 TO 4
190 BEEP .1,RND *30
200 PLOT 74+i *20,100;
    b$(i)
210 NEXT i
220>PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND *30
250 PLOT 40+i *10,80 ;z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND *30
300 PLOT 40,156-i *16;" *"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND *30
340 PLOT 40+i *10,60 ;" *"
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND *30
380 PLOT 210,60+i *16;" *"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210-i *10,140; " *"
430 NEXT i
440>PLOT 38,142: DRAW 0,
    -100
450 DRAW 182,0: DRAW 0,
    100: DRAW -182,0
```

```
460 PAUSE 100
470 BEEP .4,19 :  BEEP .2,23
480 BEEP .4,28 :  BEEP .2,26
490 BEEP .4,24 :  BEEP .2,23
500 BEEP .4,21 :  BEEP .2,23
510 BEEP .4,24 :  BEEP .2,26
520 BEEP .4,23 :  BEEP .2,21
530 BEEP .2,21 :  BEEP .2,19
540 BEEP .2,23 :  BEEP .4,26
550 BEEP .2,26
560 PAUSE 100
570 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
580 FOR i=1 TO 175
590 SCROLL 7
600 NEXT i
610 IF CODE z$(13)<>71
    THEN NEW
620 CLS
630>PRINT AT 0,17 ; "Motorul
    OTTO"
640 PAUSE 100
650 PLOT 40,60 : DRAW 0,115
660 DRAW 3,-5 : DRAW
    -6,0 : DRAW 3,5
670 PAUSE 100
680 PLOT 30,75 : DRAW 190,0
690 DRAW -5,3 : DRAW 0,
    -6 : DRAW 5,3
700 PAUSE 100
710 DEF PROC sun
720 FOR i=1 TO 3
730 BEEP .2,30 : BEEP .2,35 :
    BEEP .2,40
740 NEXT i
750 END PROC
760 PRINT AT 6,3 ; "O"
770 PAUSE 100
780 PRINT FLASH 1 ; AT
    0,3 ; "p"
790 PROC sun
800 PRINT FLASH 0 ; AT
    0,3 ; "p"
810>PAUSE 100
820 PLOT FLASH 1 ; 220,70 ;
    "V"
830 PROC sun
840 PLOT FLASH 0 ; 220,70 ;
    "V"
850 PAUSE 100
860 PLOT 50,20 : DRAW -10,0
870 DRAW 0,30 : DRAW 10,0
880 PLOT 60,50 : DRAW 160,0
890 PLOT 60,20 : DRAW 160,0
900 PLOT 30,30 : DRAW 20,0 :
    DRAW 0,5
910 PLOT 30,40 : DRAW 15,0 :
    DRAW 0,-5
920 PAUSE 100
930 PRINT FLASH 1 ; AT 8,2 ;
    "B"
940 PROC sun
950 PRINT FLASH 0 ; AT 8,2 ;
    "B"
960 PAUSE 100
970 PLOT 50,60 :  GO SUB
    2350
980 PAUSE 100
990 PLOT FLASH 1 ;65,70 ;
    "Sa"
1000 PROC sun
1010>PLOT FLASH 0 ;65,70 ;
    "Sa"
1020 PAUSE 100
1030 PLOT 50,20 : GO SUB
    2350
1040 PAUSE 100
1050 PRINT FLASH 1 ;AT 10,8 ;
    "Se"
1060 PROC sun
1070 PRINT FLASH 0 ; AT 10,8 ;
    "Se"
1080 PAUSE 100
1090 PLOT 70,49 : DRAW 0,
    -28 : DRAW 8,0 : DRAW
    0,28 : DRAW -8,0
1100 FILL 71,48
```

```
1110 PRINT AT 5,7; "0"
1120 PAUSE 0
1130 FOR x=70 TO 190
1140 PLOT x,80
1150 PAUSE 8
1160 ROLL 8;64,49;20,29
1170 NEXT x
1180 PRINT AT 5,25; "1"
1190 PLOT INVERSE 1;50,60
1200 GO SUB 2380
1210 PLOT 50,55: GO SUB 2350
1220>FOR x=190 TO 70 STEP -1
1230 PLOT x,130*(70/x)^.486
1240 ROLL 5;64,49;20,29
1250 NEXT x
1260 PRINT FLASH 1; AT 8,6; "_"
1270 BEEP .01,30: PAUSE 40
1280 PRINT FLASH 0; AT 8,6; " "
1290 PLOT 50,30: DRAW 0,5
1300 PLOT 70,130: DRAW 0,40
1310 PLOT 50,145: DRAW 40,0
1320 DRAW -5,3: DRAW 0, -6: DRAW 5,3
1330 PRINT AT 2,7; "2"
1340 PRINT AT 1,6; "Q1"
1350 PRINT AT 0,7; "3"
1360 FOR x=70 TO 190
1370 PLOT x,40+130*(70/x)^.486
1380 ROLL 8;64,49;20,29
1390 NEXT x
1400 PRINT AT 3,25; "4"
1410 PLOT INVERSE 1;50,20: GO SUB 2380
1420>PLOT 50,15: GO SUB 2350
1430 PAUSE 30
1440 PLOT 190,120: DRAW 0,-40
1450 PLOT 170,100: DRAW 40,0
1460 DRAW -5,3: DRAW 0, -6: DRAW 5,3
1470 PRINT AT 4,27; "Q2"
1480 FOR x=190 TO 70 STEP -1
1490 PAUSE 8
1500 ROLL 5;64,49;20,29
1510 NEXT x
1520 INPUT "Doriti reluarea? (d/n)"; s$
1530 IF s$="d" THEN GO TO 620
1540 IF s$="n" THEN GO TO 1560
1550 IF s$<>"n" OR s$<> "d" THEN GO TO 1520
1560 CLS
1570 PRINT AT 1,2; "Randamentul motorului Otto:"
1580 KEYWORDS 0
1590 LET i=USR "n"
1600 POKE i+0,BIN 00000000
1610>POKE i+1,BIN 00000000
1620 POKE i+2,BIN 01011000
1630 POKE i+3,BIN 00100100
1640 POKE i+4,BIN 00100100
1650 POKE i+5,BIN 00100100
1660 POKE i+6,BIN 00000100
1670 POKE i+7,BIN 00000100
1680 LET i=USR "e"
1690 POKE i+0,BIN 00000000
1700 POKE i+1,BIN 00011100
1710 POKE i+2,BIN 00100010
1720 POKE i+3,BIN 00010000
1730 POKE i+4,BIN 00010000
1740 POKE i+5,BIN 00100010
1750 POKE i+6,BIN 00011100
1760 POKE i+7,BIN 00000000
1770 LET i=USR "g"
1780 POKE i+0,BIN 00000000
1790 POKE i+1,BIN 00000000
1800 POKE i+2,BIN 01000100
1810 POKE i+3,BIN 00101010
1820 POKE i+4,BIN 00010000
```

```
1830 >POKE i+5,BIN 00010000
1840 POKE i+6,BIN 00010000
1850 POKE i+7,BIN 00000000
1860 PLOT 80,120; "ON ER-
     ROR =1-"
1870 PLOT 115,112: DRAW
     32,0
1880 PLOT 128,129; "1"
1890 PLOT 112,105; "ELSE"
1900 PLOT 120,111; "GET -1"
1910 PLOT 70,135: DRAW 0,
     -50
1920 DRAW 88,0: DRAW 0,50
1930 DRAW -88,0
1940 PRINT AT 6,0; "unde:"
1950 PRINT AT 8,2; "ELSE
     =V1/V2-raport de com-
     presie"
1960 PRINT AT 9,2; "GET=
     Cp/Cv-exponent adia-
     batic"
1970 PAUSE 0
1980 CLS
1990 PRINT AT 0,6; "Pentru
     determinarea"
2000 PRINT AT 1,2; "randa-
     mentului motorului Otto"
2010 >PRINT AT 2,10; "intro-
     duceti:"
2020 PRINT FLASH 1; AT 4,2;
     "-exponentul adiabatic
     GET ="
2030 INPUT LINE g$
2040 FOR i=1 TO LEN g$
2050 IF CODE g$(i)<45 OR
     CODE g$(i) >57 THEN
     GO TO 2030
2060 IF CODE g$(i)=47 THEN
     GO TO 2030
2070 NEXT i
2080 LET g=VAL g$
2090 IF g<=1 THEN PRINT
     #0; "GET este supraunitar
     și pozitiv!"
2100 IF g<=1 THEN PAUSE
     300
2110 IF g<=1 THEN GO TO
     2030
2120 PRINT FLASH 0; AT 4,2;
     "-exponentul adiabatic
     GET ="; g
2130 PRINT FLASH 1; AT 5,2;
     "-raportul de compresie
     ELSE ="
2140 INPUT LINE e$
2150 >FOR i=1 TO LEN e$
2160 IF CODE e$(i)<45 OR
     CODE e$(i) >57 THEN GO
     TO 2140
2170 IF CODE e$ (i)=47 THEN
     GO TO 2140
2180 NEXT i
2190 LET e=VAL e$
2200 IF e<=1 THEN PRINT
     #0; ELSE este suprauni-
     tar si pozitiv!"
2210 IF e<=1 THEN PAUSE
     300
2220 IF e<=1 THEN GO TO
     2140
2230 PRINT FLASH 0; AT 5,2
     "-raportul de compresie
     ELSE ="; e
2240 PRINT AT 6,0; ". . . .
     . . . . . . . . ."
2250 PRINT AT 8,7; "Randa-
     mentul este:"
2260 LET n=INT (1000*(1-e^
     (1-g))+.5)/10
2270 PRINT AT 9,12; "ON
     ERROR=";n; "%"
2280 >PAUSE 0
2290 INPUT "Rezolvati alta
     problema? (d/n)"; s$
2300 IF s$="d" THEN GO
     TO 1980
2310 IF s$="n" THEN GO TO
     2330
```

```
2320 IF s$<>"n" OR s$<>
     "d" THEN GO TO 2290
2330 PAUSE 0
2340 STOP
2350 DRAW 10,0: DRAW 0,-5
2360 DRAW -10,0: DRAW 0,5
2370 RETURN
2380 DRAW INVERSE 1;10,0
2390 DRAW INVERSE 1;0,-5
2400 DRAW INVERSE 1;-10,0
2410 DRAW INVERSE 1;0,5
2420 RETURN
2430 SAVE "OTTO" LINE 10
```

2.7. MOTORUL DIESEL („DIESEL")

Acest program nu diferă prea mult de cel intitulat Otto. Pompa de injecție care apare în timpul rulării programului, introduce combustibil în cilindru la momentul potrivit. Simultan cu deplasarea pistonului în cilindru se reprezintă grafic dependența $p = f(V)$, obținîndu-se ciclul după care funcționează motorul Diesel. O săgeată indică etapa în care este primită căldura Q_1, iar o a doua, indică etapa în care este cedată căldura Q_2.

În partea finală a programului este dată expresia randamentului, cu ajutorul căreia se pot rezolva probleme dacă se cunoaște exponentul adiabatic și cele două rapoarte de compresie.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 IF CODE z$(13)<>71
   THEN NEW
100 PRINT FLASH 1;AT 3,5;
    "READY"
110 PAUSE 0: CLS
120 CSIZE 8,16
130 LET a$="MOTORUL"
140 FOR i=1 TO 7
150 BEEP .1,RND*30
160 PLOT 45+i*20,120;a$(i)
170 NEXT i
180 LET b$="DIESEL"
190 FOR i=1 TO 6
200 BEEP .1,RND*30
210 PLOT 50+i*20,100;b$(i)
220 NEXT i
230 PAUSE 100
240 FOR i=1 TO 16
250 BEEP .1,RND*30
260 PLOT 40+i*10,80;z$(i)
270 NEXT i
280 PAUSE 50
290 FOR i=1 TO 6
300 BEEP .1,RND*30
310 PLOT 40,156-i*16;"*"
320 NEXT i
330 FOR i=1 TO 17
340 BEEP .1,RND*30
350 PLOT 40+i*10,60;"*"
360 NEXT i
```

```
370 FOR i=1 TO 5
380 BEEP .1,RND *30
390 PLOT 210,60+i *16;" *"
400 NEXT i
410 FOR i=1 TO 16
420 BEEP .1,RND *30
430 >PLOT  210-i *10,140;
    " *"
440 NEXT i
450 PLOT 38,142: DRAW 0,
    -100
460 DRAW 182,0: DRAW
    0,100: DRAW -182,0
470 PAUSE 100
480 BEEP .4,19: BEEP .2,23
490 BEEP .4,28: BEEP .2,26
500 BEEP .4,24: BEEP .2,23
510 BEEP .4,21: BEEP .2,23
520 BEEP .4,24: BEEP .2,26
530 BEEP .4,23: BEEP .2,21
540 BEEP .2,21: BEEP .2,19
550 BEEP .2,23: BEEP .4,26
560 BEEP .2,26
570 PAUSE 100
580 DATA 127,39,56,55,32,76,72
    67,67,32,67,46,71,79,73,65
590 FOR i=1 TO 175
600 SCROLL 7
610 NEXT i
620 CLS
630 >DEF PROC sun
640 FOR i=1 TO 4
650 BEEP .4,30: BEEP 3,35:
    BEEP .2,40
660 NEXT i
670 END PROC
680 PRINT AT 0,17; "Motorul
    DIESEL"
690 PAUSE 100
700 PLOT 40,60: DRAW 0,115
710 DRAW 3,-5: DRAW
    -6,0: DRAW 3,5
720 PRINT AT 6,3; "O"
730 PAUSE 100
740 PRINT FLASH 1;AT 0,3;
    "p"
750 PROC sun
760 PRINT FLASH 0;AT 0,3;
    "p"
770 PAUSE 100
780 PLOT 30,75: DRAW 190,0
790 DRAW -5,3: DRAW 0,-6:
    DRAW 5,3
800 PAUSE 100
810 >PLOT FLASH 1;226,72;
    "V"
820 PROC sun
830 PLOT FLASH 0;226,72;
    "V"
840 PAUSE 100
850 PLOT 50,20: DRAW -10,0
860 DRAW 0,30: DRAW 10,0
870 PLOT 60,50: DRAW 160,0
880 PLOT 60,20: DRAW 160,0
890 PLOT 35,38: DRAW 10,0
900 PLOT 35,32: DRAW 10,0
910 PAUSE 300
920 PLOT FLASH 1;15,40;
    "Pi"
930 PROC sun
940 PLOT FLASH 0;15,40;
    "Pi"
950 PAUSE 100
960 PLOT 50,60: GO SUB 2560
970 PAUSE 100
980 PLOT FLASH 1;67,68;
    "Sa"
990 PROC sun
1000 PLOT FLASH 0;67,68;
    "Sa"
1010 PAUSE 100
1020 PLOT 50,20: GO SUB 2560
1030 >PAUSE 100
1040 PRINT FLASH 1;AT 10,8;
    "Se"
1050 PROC sun
1060 PRINT FLASH 0;AT 10,8;
    "Se"
```

```
1070 PAUSE 100
1080 PRINT AT 5,7; "0"
1090 PLOT 70,49: DRAW 0,
     -28: DRAW 8,0: DRAW
     0,28: DRAW -8,0
1100 FILL 71,48
1110 PAUSE 0
1120 FOR x=70 TO 190
1130 PLOT x,80
1140 PAUSE 8
1150 ROLL 8;69,49;20,29
1160 NEXT x
1170 PRINT AT 5,25; "1"
1180 PLOT INVERSE 1;50,60:
     GO SUB 2590
1190 PLOT 50,55: GO SUB 2560
1200 FOR x=190 TO 70 STEP
     -1
1210 PLOT x,80*(190/x)^(LN
     2/LN (19/7))
1220>ROLL 5;64,49;20,29
1230 NEXT x
1240 PLOT 55,165;"2"
1250 CSIZE 8,8
1260 PLOT FLASH 1;48,38;
     "—>"
1270 CSIZE 8,16
1280 PLOT 100,175: DRAW 0,
     -35
1290 DRAW 3,5: DRAW -6,0:
     DRAW 3,-5
1300 PLOT 80,175;"Q1"
1310 FOR x=70 TO 190
1320 IF x<110 THEN PLOT x,
     160
1330 IF x<=110 THEN PAUSE
     10
1340 IF x=110 THEN PLOT
     FLASH 0; 50,38; "  "
1350 IF x=110 THEN PLOT
     120, 170; "3"
1360 IF x>=110 THEN PLOT
     x,160*(110/x)^(LN (4/3))/
     LN (19/11))
1370 ROLL 8;64,49;20,29
1380 NEXT x
1390>PRINT AT 3,25; "4"
1400 PLOT INVERSE 1;50,20:
     GO SUB 2590
1410 PLOT 50,15: GO SUB 2560
1420 PAUSE 30
1430 PLOT 190,120: DRAW 0,
     -40
1440 PLOT 170,100: DRAW 40,0
1450 DRAW -5,3: DRAW 0,
     -6: DRAW 5,3
1460 PRINT AT 4,27; "Q2"
1470 FOR x=190 TO 70 STEP
     -1
1480 PAUSE 8
1490 ROLL 5;64,49;20,29
1500 NEXT x
1510 INPUT „Doriţi reluarea?
     (d/n)"; s$
1520 IF s$="d" THEN GO TO
     620
1530 IF s$="n" THEN GO TO
     1550
1540 IF s$<>"n" OR s$<>
     "d" THEN GO TO 1510
1550 CLS
1560>PRINT AT 0,1; "Randa-
     mentul motorului Diesel:"
1570 KEYWORDS 0
1580 LET i=USR "n"
1590 POKE i+0,BIN 00000000
1600 POKE i+1,BIN 00000000
1610 POKE i+2,BIN 01011000
1620 POKE i+3,BIN 00100100
1630 POKE i+4,BIN 00100100
1640 POKE i+5,BIN 00100100
1650 POKE i+6,BIN 00000100
1660 POKE i+7,BIN 00000100
1670 LET i=USR "r"
1680 POKE i+0,BIN 00000000
1690 POKE i+1,BIN 00011000
1700 POKE i+2,BIN 00100100
```

```
1710 POKE i+3,BIN 00100100
1720 POKE i+4,BIN 00111000
1730 POKE i+5,BIN 00100000
1740 POKE i+6,BIN 00100000
1750 POKE i+7,BIN 01000000
1760 LET i=USR "g"
1770>POKE i+0,BIN 00000000
1780 POKE i+1,BIN 00000000
1790 POKE i+2,BIN 01000100
1800 POKE i+3,BIN 00101010
1810 POKE i+4,BIN 00010000
1820 POKE i+5,BIN 00010000
1830 POKE i+6,BIN 00010000
1840 POKE i+7,BIN 00000000
1850 LET i=USR "e"
1860 POKE i+0,BIN 00000000
1870 POKE i+1,BIN 00011100
1880 POKE i+2,BIN 00100010
1890 POKE i+3,BIN 00010000
1900 POKE i+4,BIN 00010000
1910 POKE i+5,BIN 00100010
1920 POKE i+6,BIN 00011100
1930 POKE i+7,BIN 00000000
1940 PLOT 54,120; "ON
     ERROR =1-"
1950 PLOT 88,112: DRAW 75,0
1960 PLOT 102,129; "ROLL
     -1"
1970 PLOT 110,137; "GET"
1980>PLOT 86,103; "GET EL-
     SE ROLL -1)"
1990 PLOT 102,111; "GET -1"
2000 PLOT 42,140: DRAW 0,
     -60
2010 DRAW 135,0: DRAW 0,60
2020 DRAW -135,0
2030 PRINT AT 7,0; "unde:"
2040 PRINT AT 8,2: "ELSE=
     V1/V2-raport de compre-
     sie"
2050 PRINT AT 9,2; "ROLL=
     V3/V2-raport de compre-
     sie"
2060 PRINT AT 10,2; "GET=
     =Cp/Cv-exponent adia-
     batic"
2070 PAUSE 0
2080 CLS
2090 PRINT AT 0,6; "Pentru
     determinarea"
2100 PRINT AT 1,1; "randa-
     mentului motorului Diesel"
2110 PRINT AT 2,10; "intro-
     duceti:"
2120>PRINT FLASH 1; AT
     4,2; "-exponentul adia-
     batic GET ="
2130 INPUT LINE g$
2140 FOR i=1 TO LEN g$
2150 IF CODE g$(i)<45 OR
     CODE g$(i)>57 THEN GO
     TO 2130
2160 IF CODE g$(i)=47 THEN
     GO TO 2130
2170 NEXT i
2180 LET g=VAL g$
2190 IF g<=1 THEN PRINT
     #0;"GET este supraunitar
     si pozitiv!"
2200 IF g<=1 THEN PAUSE
     300
2210 IF g<=1 THEN GO TO
     2130
2220 PRINT FLASH 0; AT 4,2;
     "-exponentul adiabatic
     GET ="; g
2230 PRINT FLASH 1; AT 5,2;
     "-raportul de compresie
     ELSE ="
2240 INPUT LINE e$
2250 FOR i=1 TO LEN e$
2260>IF CODE e$(i) <45 OR
     CODE e$(i)>57 THEN GO
     TO 2240
2270 IF CODE e$(i)=47 THEN
     GO TO 2240
2280 NEXT i
2290 LET e=VAL e$
```

```
2300 IF e<=1 THEN PRINT
     #0; "ELSE este supraunitar si pozitiv!"
2310 IF e<=1 THEN PAUSE
     300
2320 IF e<=1 THEN GO TO
     2240
2330 PRINT FLASH 0; AT 5,2;
     "-raportul de compresie
     ELSE = "; e
2340 PRINT FLASH 1; AT 6,2;
     "-raportul de compresie
     ROLL = "
2350 INPUT LINE r$
2360 FOR i=1 TO LEN r$
2370 IF CODE r$(i)<45 OR
     CODE r$(i)>57 THEN GO
     TO 2350
2380 IF CODE r$(i)=47 THEN
     GO TO 2350
2390 NEXT i
2400>LET r=VAL r$
2410 IF r<=1 THEN PRINT
     #0; "ROLL este supraunitar si pozitiv!"
2420 IF r<=1 THEN PAUSE
     300
2430 IF r<=1 THEN GO TO
     2350
2440 PRINT FLASH 0; AT 6,2;
     "-raportul de compresie
     ROLL = ";r
2450 PRINT AT 7,0; ". . . . .
     . . . . . . . ."
2460 PRINT AT 8,7; "Randamentul este:"
2470 LET n=INT (1000 *
     (1-(r^g-1)/(g *e^(g-1) *
     (r-1)))+.5)/10
2480 PRINT AT 9,12; "ON
     ERROR = ";n;"%"
2490 PAUSE 0
2500 INPUT "Rezolvati alta
     problema? (d/n)";s$
2510 IF s$="d" THEN GO TO
     2080
2520 IF s$="n" THEN GO
     TO 2540
2530>IF s$<>"n" OR s$<>
     "d" THEN GO TO 2500
2540 PAUSE 0
2550 STOP
2560 DRAW 10,0: DRAW 0,-5
2570 DRAW -10,0: DRAW
     0,5
2580 RETURN
2590 DRAW INVERSE 1;10,0
2600 DRAW INVERSE 1;0,-5
2610 DRAW INVERSE 1;-10,0
2620 DRAW INVERSE 1;0,5
2630 RETURN
2640 SAVE "DIESEL "LINE 10
```

2.8. STALAGMOMETRUL („PIPETA")

În manualul de clasa a X-a, există un exercițiu a cărui formulare parțială este următoarea: „Elaborați o metodă de determinare a coeficientului de tensiune superficială utilizînd o pipetă". Acest exercițiu mi-a sugerat ideea de a realiza un program cu ajutorul căruia să rezolv următoarea problemă de capilaritate:

„La 18 grade C densitatea apei este 999 kg/m³, iar coeficientul de tensiune superficială 0,073 N/m. Să se afle coeficientul de tensiune

superficială al alcoolului etilic știind că densitatea acestuia la 18 grade C este 790 kg/m^3".

Analizînd datele problemei se observă că acestea sînt insuficiente pentru a o rezolva. Rulînd programul se poate constata că rezolvarea acestei probleme cere efectuarea unei experiențe, în care se folosește o pipetă specială și cele două lichide.

Să-mi fie cu iertare dacă nu am reușit reproducerea fidelă a sunetului pe care o picătură de lichid îl produce la impactul cu suprafața liberă!

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="STALAGMO-
    METRUL"
130 FOR i=1 TO 14
140 BEEP .1,RND*30
150 PLOT 55+i*10,110; a$
    (i)
160 NEXT i
170 PAUSE 100
180 FOR i=1 TO 16
190 BEEP .1,RND*30
200 PLOT 40+i*10,80; z$(i)
210 NEXT i
220 >PAUSE 50
230 FOR i=1 TO 6
240 BEEP .1,RND*30
250 PLOT 40,156-i*16; "*"
260 NEXT i
270 FOR i=1 TO 17
280 BEEP .1,RND*30
290 PLOT 40+i*10,60; "*"
300 NEXT i
310 FOR i=1 TO 5
320 BEEP .1,RND*30
330 PLOT 210,60+i*16; "*"
340 NEXT i
350 FOR i=1 TO 16
360 BEEP .1,RND*30
370 PLOT 210-i*10,140; "*"
380 NEXT i
390 PAUSE 50: PLOT 38,142
400 DRAW 0, -100: DRAW
    182,0
410 DRAW 0,100: DRAW
    -182,0
420 PAUSE 100
430 BEEP .4,19: BEEP .2,23
440 >BEEP .4,28: BEEP .2,26
450 BEEP .4,24: BEEP .2,23
460 BEEP .4,21: BEEP .2,23
470 BEEP .4,24: BEEP .2,26
480 BEEP .4,23: BEEP .2,21
490 BEEP .2,21: BEEP .2,19
500 BEEP .2,23: BEEP .4,26
510 BEEP .2,26
520 PAUSE 100
530 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
540 FOR i=1 TO 175
550 SCROLL 7
560 NEXT i
570 IF CODE z$(13)<>71
    THEN NEW
580 CSIZE 0: CLS
590 LET a$="La 18 grd C":
    LET y=170
```

```
600 GO SUB 2150
610 LET a$="densitatea apei"
    : LET y=160
620>GO SUB 2150
630 LETa$="este 999kg/m^3":
    LET y=150
640 GO SUB 2150
650 LET a$="iar coeficientul":
    LET y =140
660 GO SUB 2150
670 LET a$="de  tensiune":
    LET y=130
680 GO SUB 2150
690 LET a$="superficiala":
    LET y=120
700 GO SUB 2150
710 LET a$="0.073 N/m. Sa
    se": LET y=110
720 GO SUB 2150
730 LET a$="afle coeficien-
    tul": LET y=100
740 GO SUB 2150
750 LET a$="de  tensiune":
    LET y=90
760 GO SUB 2150
770>LET a$="superficiala al"
    : LET y=80
780 GO SUB 2150
790 LET a$="alcoolului  eti-
    lic": LET y=70
800 GO SUB 2150
810 LET a$="stiind ca": LET
    y=60
820 GO SUB 2150
830 LET a$="densitatea":
    LET y=50
840 GO SUB 2150
850 LET a$="acestuia la 18":
    LET y=40
860 GO SUB 2150
870 LET a$="grd C este": LET
    y=30
880 GO SUB 2150
890 LET a$="790 kg/m^3.":
    LET y=20
900 GO SUB 2150
910 PAUSE 200
920>FOR y=175 TO 5 STEP
    -10
930 BEEP .1,35: PLOT 138,
    y: DRAW 0,-5
940 NEXT y: PAUSE 0
950 PLOT 150,10
960 DRAW 100,0: PAUSE 100
970 FOR i=1 TO 20
980 BEEP .1,40: PLOT
    145+i*5,5: DRAW 5,5
990 NEXT i: PAUSE 100
1000 FOR y=10 TO 30
1010 PLOT 170, y: DRAW
     60,0
1020 NEXT y: PAUSE 100
1030 DEF PROC sun
1040 FOR i=1 TO 4
1050 BEEP .3,30: BEEP .2,35:
     BEEP .1,40
1060 NEXT i
1070 END PROC
1080 PLOT FLASH 1;145,24;
     "vas"
1090 PROC sun
1100>PLOT FLASH 0; 145,24;
     "vas": PAUSE 200
1110 PLOT 190,140: DRAW 0,
     -60
1120 DRAW 8,0: DRAW 0,-5
1130 PLOT 210,140: DRAW 0,
     -60
1140 DRAW -8,0: DRAW 0,
     -5
1150 PAUSE 100
1160 PLOT FLASH 1; 140,90;
     "pipeta"
1170 PROC sun
1180 PLOT FLASH 0;140,90;
     "pipeta"
1190 PAUSE 100
```

```
1200 PLOT 185,120: DRAW
     5,0
1210 PAUSE 100
1220 PLOT FLASH 1; 144,124;
     "reper"
1230 PROC sun
1240 PLOT FLASH 0; 144,124;
     "reper"
1250 PAUSE 0
1260 PRINT FLASH 1; AT
     0,22; "apa"
1270 >FOR y=81 TO 120
1280 PLOT 191,y
1290 DRAW 18,0: NEXT y
1300 PAUSE 0
1310 FOR n=0 TO 10
1320 FOR y=120-40/11*n TO
     120-40/11*(n+1) STEP
     -1
1330 PLOT INVERSE 1;191,y
1340 DRAW INVERSE 1;18,0
1350 NEXT y
1360 FOR y=75 TO 38 STEP
     -1
1370 PLOT 196,y;"0"
1380 NEXT y
1390 PLOT OVER 1;196,38; "O"
1400 BEEP .01,40
1410 PRINT AT 0,28; "n=";
     n+1
1420 PAUSE 10
1430 NEXT n
1440 PRINT FLASH 0; AT
     0,22; "apa"
1450 PAUSE 0
1460 PRINT FLASH 1; AT 1,20;
     "alcool"
1470 >FOR y=81 TO 121
1480 PLOT 191, y: DRAW
     18,0
1490 NEXT y
1500 PAUSE 0
1510 FOR n=0 TO 28
1520 FOR y=121-40/29*n
     TO 121-40/29*(n+1)
     STEP -1
1530 PLOT INVERSE 1;191,y
1540 DRAW INVERSE 1;18,0
1550 NEXT y
1560 FOR y=75 TO 38 STEP
     -1
1570 PLOT 196, y; "o": NEXT
     y
1580 PLOT OVER 1;196,38; "o"
1590 BEEP .01,40
1600 PRINT AT 1,27; "n'=";
     n+1
1610 PAUSE 5
1620 NEXT n
1630 PRINT FLASH 0; AT
     1,20; "alcool"
1640 PAUSE 0
1650 INPUT "Reluam experi-
     enta" (d/n)";a$
1660 >IF a$="d" THEN GO
     TO 1690
1670 IF a$="n" THEN GO TO
     1760
1680 IF a$<>"n" OR a$<>
     "d" THEN GO TO 1650
1690 PLOT 140,90; " "
1700 FOR i=0 TO 21
1710 FOR j=18 TO 31
1720 PRINT AT i,j; " "
1730 NEXT j: NEXT i
1740 PLOT 140,90; " "
1750 GO TO 950
1760 INPUT "Ce rezultat ati ob-
     obtinut?";s
1770 IF s<=22e-3 AND s>=
     21e-3 THEN PRINT #0;
     "BRAVO!"
1780 IF s<=22e-3 AND s>=
     21e-3 THEN PAUSE 0
1790 IF s<=22e-3 AND
     s>=21e-3 THEN STOP
1800 >IF s<21e-3 OR s>
```

```
      22e−3  THEN  PRINT
      #0; "GRESALA!"
1810 IF s<21e−3 OR s>22e−3
      THEN PAUSE 300
1820 IF s<21e−3 OR s>22e−3
      THEN PRINT #0;  AT
      0,0; "  "
1830 FOR i=17 TO 21
1840 FOR j=18 TO 31
1850 PRINT AT i, j; " "
1860 NEXT j: NEXT i
1870 KEYWORDS 0
1880 LET i=USR "s"
1890 POKE i+0,BIN  00000000
1900 POKE i+1,BIN  00000000
1910 POKE i+2,BIN  00111110
1920 POKE i+3,BIN  01001000
1930 POKE i+4,BIN  01001000
1940 POKE i+5,BIN  01001000
1950 POKE i+6,BIN  00110000
1960 POKE i+7,BIN  00000000
1970>PRINT AT 14,22; "Dedu-
      ceti:"
1980 PLOT 175,35; "SCROLL"
1990 PLOT 182,40; "  "
2000 PLOT 187,34; "="
2010 PLOT 200,30: DRAW 24,0
2020 LET i=USR "r"
2030 POKE i+0,BIN  00000000
2040 POKE i+1,BIN  00011100
2050 POKE i+2,BIN  00100010
2060 POKE i+3,BIN  00100010
2070 POKE i+4,BIN  00100010
2080 POKE i+5,BIN  00111100
2090 POKE i+6,BIN  00100000
2100 POKE i+7,BIN  01000000
2110 PLOT 200,40; "n ROLL"
2120 PLOT 200,29; "n' ROLL"
2130 PLOT 230,35; "SCROLL"
2140 PAUSE 0: STOP
2150 FOR i=1  TO LEN a$
2160 BEEP .06, RND *30
2170 PLOT 70−4 *LEN a$+8
      *i−8,y ;a$(i)
2180>NEXT i
2190 RETURN
2200 SAVE "Pipeta" LINE 10
```

2.9. IZOTERMELE LUI ANDREWS („ANDREWS")

Într-un cilindru cu piston în mișcare este comprimat CO_2. Simultan cu deplasarea pistonului se reprezintă grafic $p = f(V)$, pentru diferite temperaturi. Se obține astfel o familie de izoterme, cunoscute sub numele de izotermele lui Andrews. În momentul cînd apare palierul, CO_2 începe să se transforme în lichid, cantitatea acestuia crește, iar cantitatea de vapori saturanți scade. Cînd cilindrul este plin cu lichid, presiunea crește aproape brusc.

Graficul semicantitativ permite citirea presiunii corespunzătoare diferitelor puncte de pe cele cinci izoterme.

În ultima parte a programului se reprezintă prin puncte curba de saturație, care împreună cu izoterma critică împart spațiul fazelor în patru regiuni și anume: zona vaporilor nesaturanți, a vaporilor saturanți în echilibru cu lichidul, zona lichidului și aceea a gazului.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i = 1 TO 16
50 READ d
60 LET z$(i) = CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1; AT
   3,5; "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="IZOTERMELE
    LUI"
130 FOR i=1 TO 14
140 BEEP 1, RND *30
150 PLOT 50+i * 10,110 ;a$(i)
160 NEXT i
170 LET b$="ANDREWS"
180 FOR i=1 TO 7
190 BEEP .1,RND *30
200 PLOT 80+i *10,90; b$(i)
210 NEXT i
220 >PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND * 30
250 PLOT 40+i *10,70; z$ (1)
260 NEXT i
270 PAUSE 100
280 FOR i=1 TO 6
290 BEEP .1,RND * 30
300 PLOT 40,146-i *16;" *"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND *30
340 PLOT 40+i *10,50; " *"
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND *30
380 PLOT 210,50+i *16; " *"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210-i *10,130;
    " *"
430 NEXT i
440 >PAUSE 50
450 PLOT 38,133: DRAW 0,
    -103
460 DRAW 182,0: DRAW 0,
    103: DRAW -182,0
470 PAUSE 100
480 BEEP .4,19: BEEP .2,23
490 BEEP .4,28: BEEP .2,26
500 BEEP .4,24: BEEP .2,23
510 BEEP .4,21: BEEP .2,23
520 BEEP .4,24: BEEP .2,26
530 BEEP .4,23: BEEP .2,21
540 BEEP .2,21: BEEP .2,19
550 BEEP .2,23: BEEP .4,26
560 BEEP .2,26
570 PAUSE 200
580 DATA 127,39,56,55,32,76,72,
    67,67,32,67,46,71,79,73,65
590 FOR i=i TO 175: SCROL
    7: NEXT i
600 PRINT AT 0,10; "Izoter-
    mele lui Andrews"; AT 1,14
    ; "(idealizate)"
610 > IF CODE z$(13) <> 71
    THEN NEW
620 PAUSE 200
630 PLOT 30,50: DRAW
    0,125: DRAW 3,-5:
    DRAW -6,0: DRAW 3,5
640 PAUSE 200
650 DEF PROC sun
660 FOR i=1 TO 4
670 BEEP .3,30: BEEP .2,35:
    BEEP .1,40
680 NEXT i
690 END PROC
700 CSIZE 0: PRINT FLASH
    1; AT 0,4; "p(atm)"
710 PROCsun: PRINT FLASH
    0; AT 0,4; "p(atm)":
    CSIZE 8,16
```

```
720 PAUSE 200
730 FOR y=60 TO 160 STEP
    20
740 BEEP .05,y/5
750 PLOT 28,y: DRAW 4,0
760 PAUSE 50
770 NEXT y
780>PAUSE 100
790 BEEP .05,5
800 PLOT 10,69;"50"
810 PAUSE 50
820 BEEP .05,10
830 PLOT 10,89;"60"
840 PAUSE 50
850 BEEP .05,15
860 PLOT 10,109;"70"
870 PAUSE 50
880 BEEP .05,20
890 PLOT 10,129;"80"
900 PAUSE 50
910 BEEP .05,25
920 PLOT 10,149;"90"
930 PAUSE 50
940 BEEP .05,30
950 PLOT 2,169;"100"
960 PAUSE 200
970 PLOT 30,50: DRAW 170,0
980 DRAW -5,-3: DRAW
    0,6: DRAW 5,-3
990>PAUSE 200
1000 CSIZE 0
1010 PRINT FLASH 1;AT 16,
     24;"V"
1020 PROC sun
1030 PRINT FLASH 0;AT 16,
     24;"V": CSIZE 8,16
1040 PAUSE 200
1050 PLOT 20,24: DRAW 10,0
1060 DRAW 0,-14: DRAW
     140,0
1070 PLOT 20,26: DRAW 10,0
1080 DRAW 0,14: DRAW 140,0
1090 PAUSE 200
1100 CIRCLE 10,25,10
1110 PAUSE 200
1120 PROC sun
1130 PLOT 7,32;"M"
1140 PAUSE 200
1150 PRINT #0; FLASH 1;
     AT 0,0; "Cilindrul contine
     CO2"
1160 PAUSE 200
1170>PRINT #0; FLASH 0;
     AT 0,0; "Cilindrul contine
     CO2"
1180 PAUSE 200
1190 FOR a=40 TO 120 STEP
     10: BEEP .05,40
1200 PLOT (a-5),15: BEEP
     .05,40
1210 PLOT a,20: BEEP .05,40
1220 PLOT (a-5),25: BEEP
     .05,40
1230 PLOT a,30: BEEP .05,40
1240 PLOT (a-5),35: NEXT a
1250 PAUSE 200
1260 PRINT FLASH 1;AT 6,20;
     "t1=13,1 grdC"
1270 PAUSE 0
1280 FOR x=122 TO 38 STEP
     -1
1290 BEEP 12/x,x/90
1300 IF x>=105 THEN PLOT
     x,6080/x
1310 IF x<105 AND x>42
     THEN PLOT x,58
1320>IF x<=105 AND x>=42
     THEN PLOT 31, (11-28/63
     *(x-105)): DRAW (x-
     31),0
1330 IF x<=42 THEN PLOT
     x,1129-25.5*x
1340 IF x<=42 AND x>=39
     THEN DRAW -1,25.5
1350 PLOT x,11: DRAW 0,28
1360 PLOT OVER 1;x+1,11
1370 DRAW OVER 1;0,28
```

```
1380 PLOT INVERSE 1;123,11
1390 DRAW INVERSE 1;0,28
1400 NEXT x
1410 PAUSE 0
1420 PLOT INVERSE 1;38,11
1430 DRAW INVERSE 1;0,28
1440 FOR a=0 TO 28
1450 PLOT INVERSE 1;31,
     (11+a)
1460 DRAW INVERSE 1;11,0
1470 NEXT a
1480 PRINT FLASH 0;AT 6,20;
     "t1=13,1 grdC"
1490>PRINT FLASH 1;AT
     5,20; "t2=21,5 grdC"
1500 FOR a=40 TO 130 STEP
     10
1510 BEEP .05,40: PLOT
     (a-5),15
1520 BEEP .05,40: PLOT a,20
1530 BEEP .05,40: PLOT
     (a-5),25
1540 BEEP .05,40: PLOT a,30
1550 BEEP .05,40: PLOT
     (a-5),35
1560 NEXT a
1570 FOR x=131 TO 41 STEP
     -1
1580 BEEP 12/x,x/90
1590 IF x>=82 THEN PLOT
     x,6560/x
1600 IF x<82 AND x>50 THEN
     PLOT x,80
1610 IF x<=82 AND x>=50
     THEN PLOT 31, (11-28/
     32*(x-82)): DRAW
     (x-31),0
1620 IF x<=50 THEN PLOT
     x,4720/9-80/9*x
1630 IF x<=50 AND x>41
     THEN DRAW -1,80/9
1640 PLOT x,11: DRAW 0,28
1650>PLOT OVER 1;x+1,11:
     DRAW OVER 1;0,28
1660 PLOT INVERSE 1;132,11
1670 DRAW INVERSE 1;0 28
1680 NEXT x
1690 PAUSE 0
1700 PLOT INVERSE 1;41,11
1710 DRAW INVERSE 1;0,28
1720 FOR a=0 TO 28
1730 PLOT INVERSE 1;31,
     (11+a)
1740 DRAW INVERSE 1;19,0
1750 NEXT a
1760 PRINT FLASH 0;AT 5,20;
     "t2=21,5 grdC"
1770 PRINT FLASH 1; INK 2;
     AT 4,17; "tc=t3=31,1
     grdC"
1780 FOR a=40 TO 140 STEP 10
1790 BEEP .05,40: PLOT (a-5),
     15
1800 BEEP .05,40: PLOT a,20
1810 BEEP .05,40: PLOT (a-5),
     25
1820 BEEP .05,40: PLOT a,30
1830 BEEP .05,40: PLOT (a-5),
     35
1840>NEXT a
1850 FOR x=141 TO 44 STEP
     -1
1860 IF x=64 THEN FILL 56,13
1870 BEEP 12/x,x/90
1880 PLOT x,7040/x
1890 IF x>44 THEN DRAW
     -1,7040/(x-1)-7040/x
1900 PLOT x,11: DRAW 0,28
1910 PLOT OVER 1;x+1,11
1920 DRAW OVER 1;0,28
1930 PLOT INVERSE 1;142,11
1940 DRAW INVERSE 1;0,28
1950 NEXT x
1960 CIRCLE 65,108,2
1970 PRINT FLASH 1;AT 3,9;
     "Pc"
1980 PROC sun
```

```
1990 PRINT FLASH 0 ;AT 3,9 ;
     "Pc"
2000 PAUSE 0
2010 FOR a=0 TO 28
2020 PLOT  INVERSE 1 ;31,11
     +a
2030 DRAW  INVERSE 1 ;19,0
2040 NEXT a
2050>PLOT INVERSE 1 ;20,25
2060 DRAW  INVERSE 1 ;10,0
2070 PLOT INVERSE 1 ;44,11
2080 DRAW INVERSE 1 ;0,28
2090 PRINT FLASH 0 ; INK 2 ;
     AT 4,17 ; "tc=t3=31,1
     grdC"
2100 PRINT FLASH 1 ;AT 3,20 ;
     "t4=32,5 grdC"
2110 FOR a=40 TO 150 STEP 10
2120 BEEP .05,40 : PLOT
     (a-5),15
2130 BEEP .05,40 : PLOT a,20
2140 BEEP .05,40 : PLOT
     (a-5),25
2150 BEEP .05,40 : PLOT a,30
2160 BEEP .05,40 : PLOT
     (a-5),35
2170 NEXT a
2180 FOR x=150 TO 47 STEP
     -1
2190 BEEP 12/x,x/90
2200 PLOT x,7520/x
2210 IF x>47 THEN DRAW
     -1,7520/(x-1)-7520/x
2220 PLOT x,11 : DRAW 0,28
2230 PLOT OVER 1 ;x+1,11
2240>DRAW OVER 1 ;0,28
2250 PLOT INVERSE 1 ;151,11
2260 DRAW INVERSE 1 ;0,28
2270 NEXT x
2280 PAUSE 0
2290 PLOT INVERSE 1 ;47,11
2300 DRAW INVERSE 1 ;0,28
2310 PRINT FLASH 0 ;AT 3,20 ;
     "t4=32,5 grdC"
2320 PRINT FLASH 1 ;AT 2,20 ;
     "t5=35,5 grdC"
2330 FOR a=40 TO 160 STEP 10
2340 BEEP .05,40 : PLOT
     (a-5),15
2350 BEEP .05,40 : PLOT a,20
2360 BEEP .05,40 : PLOT
     (a-5),25
2370 BEEP .05,40 : PLOT a,20
2380 BEEP .05,40 : PLOT
     (a-5),25
2390 BEEP .05,40 : PLOT a,30
2400 BEEP .05,40 : PLOT
     (a-5),35
2410 NEXT a
2420 FOR x=160 TO 50 STEP
     -1
2430 BEEP 12/x,x/90
2440>PLOT x,8000/x
2450 IF x>50 THEN DRAW
     -1,8000/(x-1)-8000/x
2460 PLOT x,11 : DRAW 0,28
2470 PLOT OVER 1 ;x+1,11
2480 DRAW OVER 1 ;0,28
2490 PLOT INVERSE 1 ;161,11
2500 DRAW INVERSE 1 ;0,28
2510 NEXT x
2520 PRINT FLASH 0 ;AT 2,20 ;
     "t5=35,5 grdC"
2530 PLOT 41,54 : PLOT 44,65
2540 PLOT 47,72 : PLOT 52,88
2550 PLOT 55,95 : PLOT 60,100
2560 PLOT 70,99 : PLOT 75,92
2570 PLOT 80,85 : PLOT 85,73
2580 PLOT 91,69 : PLOT 100,61 :
     PLOT 108,52
2590 PAUSE 0
2600 STOP
2610 SAVE "ANDREWS" LINE
     10
```

3. FENOMENE ELECTRICE ȘI MAGNETICE

3.1. DEVIAȚIA ELECTRONULUI ÎN CÎMP ELECTRIC UNIFORM („DEVEL")

Acest program poate fi utilizat pentru a pune în evidență traiectoria urmată de un electron care străbate o regiune din spațiu în care există un cîmp electric uniform, apoi își continuă liber drumul. Cîmpul electric este creat de două plăci metalice paralele, între care, după dorință, se pot aplica diferite tensiuni, de polarități diferite.

Programul a fost astfel realizat încît tensiunea aplicată plăcilor să fie cuprinsă între —320 și 320 Volți. Folosind o riglă pentru măsurarea deviației, se poate observa că aceasta este proporțională cu tensiunea aplicată plăcilor. Pentru a ușura măsurarea deviației este indicat ca prima tensiune introdusă să fie de zero Volți.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="ELECTRON
   IN"
130 FOR i=1 TO 11
140 BEEP .1,RND *30
150 PLOT 65+i *10,120;a$(i)
160 NEXT i
170 LET b$="CIMP ELEC-
   TRIC"
180 FOR i=1 TO 13
190 BEEP .1,RND *30
200 PLOT 55+i *10,100;b$(i)
210 NEXT i
220 PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND *30
250 PLOT 40+i *10,80;z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND *30
300 PLOT 40,156-i *16;" * "
310 NEXT i
```

```
320 FOR i=1 TO 17
330 BEEP .1,RND *30
340 PLOT 40+i * 10,60 ;" * "
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND *30
380 PLOT 210,60+i * 16 ;" * "
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210-i * 10,140 ;" * "
430 NEXT i
440 >PAUSE 50 : PLOT 38,142
450 DRAW 0,-100 : DRAW
    182,0
460 DRAW 0,100 : DRAW
    -182,0
470 PAUSE 100
480 BEEP .4,19 : BEEP .2,23
490 BEEP .4,28 : BEEP .2,26
500 BEEP .4,24 : BEEP .2,23
510 BEEP .4,21 : BEEP .2,23
520 BEEP .4,24 : BEEP .2,26
530 BEEP .4,23 : BEEP .2,21
540 BEEP .2,21 : BEEP .2,19
550 BEEP .2,23 : BEEP .4,26
560 BEEP .2,26
570 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
580 PAUSE 100
590 IF CODE z$(13)<>71
    THEN NEW
600 FOR i=1 TO 175
610 SCROLL 7
620 NEXT i
630 PLOT 0,110 : DRAW 60,0
640 >PLOT 0,70 : DRAW 60,0
650 PAUSE 100
660 PLOT 240,10 : DRAW 0,160
670 PAUSE 100
680 LET a$="ECRAN"
690 FOR i=1 TO LEN a$
700 BEEP .3,35
710 PRINT AT 2 * i-1,31 ;a$(i)
720 NEXT i
730 PAUSE 100
740 INPUT "Introduceţi tensi-
    unea !"; LINE u$
750 FOR i=1 TO LEN u$
760 IF CODE u$(i)<45 OR
    CODE u$(i)>57 THEN GO
    TO 740
770 IF CODE u$(i)=47 THEN
    GO TO 740
780 NEXT i
790 LET u=VAL u$
800 IF u>320 OR u<-320
    THEN PRINT #0 ; "Ten-
    siunea apartine [-320,320]
    V !"
810 >IF u>320 OR u<-320
    THEN PAUSE 500
820 IF u>320 OR u<-320
    THEN GO TO 740
830 IF u>0 THEN PRINT AT
    3,3 ; FLASH 1 ; "-" ; AT
    7,3 ;"+"
840 IF u<0 THEN PRINT AT
    3,3 ; FLASH 1 ; "+" ;AT
    7,3 ;"-"
850 IF u=0 THEN PRINT AT
    3,3 ;" " ;AT 7,3 ;" "
860 FOR x=0 TO 240
870 IF x<=60 THEN PLOT
    x,90-1e-5 * u * x^2
880 IF x>=60 THEN PLOT
    x,90-36e-3 * u-12e-4 *
    u * (x-60)
890 NEXT x
900 GO TO 740
910 SAVE "Devel" LINE 10
```

3.2. DEVIAȚIA ELECTRONULUI ÎN CÎMP MAGNETIC UNIFORM („ELICE")

Polii unui magnet permanent creează un cîmp magnetic de inducție B. În acest cîmp este trimis un electron sub unghiuri și cu viteze dorite de utilizator. Viteza de introducere în cîmp a electronului este exprimată în unități arbitrare (ua) și nu va trebui să depășească valoarea 3. Se pun în evidență traiectorii circulare, helicoidale, rectilinii, se trag concluzii în legătură cu dependența razei sau a pasului elicei de viteza electronului, respectiv a unghiului dintre viteză și inducția magnetică.

Dacă viteza de introducere a electronului în cîmp depășește 3 unități arbitrare, sau unghiul dintre viteză și inducția magnetică nu este cuprins între 0 și 90 grade, sîntem invitați să respectăm aceste intervale.

În partea de jos a ecranului apare o diagramă vectorială, săgeata ce reprezintă vectorul viteză schimbîndu-și orientarea în funcție de unghiul introdus.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 DATA 127,39,56,55,32,76,72
   67,67,32,67,46,71,79,73,65
90 CSIZE 16,24
100 PRINT FLASH 1;AT 3,5;
    "READY"
110 PAUSE 0: CLS
120 CSIZE 8,16
130 LET a$="ELECTRON
    IN"
140 FOR i=1 TO 11
150 BEEP .1,RND*30
160 PLOT 65+i*10,120;a$(i)
170 NEXT i
180 LET b$="CIMP MAGNE-
    TIC"
190 FOR i=1 TO 13
200 BEEP .1,RND*30
210 >PLOT 55+i*10,100;b$(i)
220 NEXT i
230 PAUSE 100
240 FOR i=1 TO 16
250 BEEP .1,RND*30
260 PLOT 40+i*10,80;z$(i)
270 NEXT i
280 PAUSE 50
290 FOR i=1 TO 6
300 BEEP .1,RND*30
310 PLOT 40,156-i*16;"*"
320 NEXT i
330 FOR i=1 TO 17
340 BEEP .1,RND*30
350 PLOT 40+i*10,60;"*"
360 NEXT i
370 FOR i=1 TO 5
380 BEEP .1,RND*30
390 PLOT 210,60+i*16;"*"
400 NEXT i
410 FOR i=1 TO 16
420 BEEP .1,RND*30
430 >PLOT 210-i*10,140;
    "*"
```

```
440 NEXT i
450 PLOT 38,142: DRAW 0,
    -100
460 DRAW 182,0: DRAW
    0,100: DRAW -182,0
470 PAUSE 200
480 DATA .4,19,.2,23,.4,28,.2,26,
    .4,24,.2,23,.4,21,.2,23,.
    4,24,.2,26,.4,23,.2,21,.2,21,
    .2,19,.2,23,.4,26,.2,26
490 FOR i=1 TO 17
500 READ a,b
510 BEEP a,b
520 NEXT i
530 IF CODE z$(13)<>71
    THEN NEW
540 PAUSE 100
550 FOR i=1 TO 176: SCROLL
    7: NEXT i
560 CLS
570 LET t=200
580 PLOT 0,50: DRAW 20,0
590>DRAW 0,100: DRAW
    20,20
600 DRAW 0,-100: DRAW
    -20,-20
610 PLOT 0,150: DRAW 20,0
620 PLOT 0,170: DRAW 40,0
630 PAUSE t
640 DEF PROC sun
650 FOR i=1 TO 3
660 BEEP .2,30: BEEP .2,35:
    BEEP .2,40
670 NEXT i
680 END PROC
690 LET a$="NORD"
700 FOR i=1 TO 4
710 PLOT FLASH 1;8,157-i
    *20;a$(i)
720 NEXT i
730 PROC sun
740 FOR i=1 TO 4
750 PLOT FLASH 0;8,157-i
    *20;a$(i)
760 NEXT i
770 PAUSE t
780>PLOT 255,50: DRAW
    -25,0
790 DRAW 0,100: DRAW
    20,20: DRAW 5,0
800 PLOT 255,150: DRAW
    -25,0
810 PAUSE t
820 LET b$="SUD"
830 FOR i=1 TO 5
840 PLOT FLASH 1;240,157-
    i*16;b$(i)
850 NEXT i
860 PROC sun
870 FOR i=1 TO 5
880 PLOT FLASH 0;240,157-
    i*16;b$(i)
890 NEXT i
900 PAUSE t
910 FOR i=0 TO 4
920 PAUSE 4
930 BEEP .2,30
940 PLOT 35,155-20*i
950 DRAW 40,0: DRAW -5,2
960 DRAW 0,-4: DRAW 5,2
970>PAUSE 4
980 BEEP .1,30
990 PLOT 25,145-20*i
1000 DRAW 40,0: DRAW -5,2
1010 DRAW 0,-4: DRAW 5,2
1020 NEXT i
1030 PAUSE t
1040 PLOT FLASH 1;56,172;
     "B"
1050 PLOT 53,173
1060 DRAW 17,0: DRAW -5,2
1070 DRAW 0,-4: DRAW 5,2
1080 PROC sun
1090 PLOT FLASH 0;56,172;
     "B"
1100 PAUSE t
1110 BEEP .5,20
1120 CIRCLE 100,20,3
```

```
1130 PAUSE t
1140 PLOT FLASH 1;88,15;
     "—e"
1150 PROC sun
1160 PLOT FLASH 0;88,15;
     "—e"
1170 PAUSE 50
1180 PLOT 100,20
1190 >DRAW 50,0: DRAW —5,2
1200 DRAW 0,—4: DRAW 5,2
1210 PAUSE t
1220 BEEP .5,20
1230 PLOT 125,14;"B"
1240 PLOT 122,16
1250 DRAW 12,0: DRAW —5,2
1260 DRAW 0,—4: DRAW 5,2
1270 KEYWORDS 0
1280 LET i=USR "e"
1290 POKE i+0,BIN 00000000
1300 POKE i+1,BIN 00011110
1310 POKE i+2,BIN 00100000
1320 POKE i+3,BIN 01000000
1330 POKE i+4,BIN 01111110
1340 POKE i+5,BIN 01000000
1350 POKE i+6,BIN 00100000
1360 POKE i+7,BIN 00011110
1370 LET i=USR "a"
1380 POKE i+0,BIN 00000000
1390 POKE i+1,BIN 00000010
1400 POKE i+2,BIN 00110100
1410 >POKE i+3,BIN 01001000
1420 POKE i+4,BIN 01001000
1430 POKE i+5,BIN 01001000
1440 POKE i+6,BIN 00110110
1450 POKE i+7,BIN 00000000
1460 LET i=USR "p"
1470 POKE i+0,BIN 00000000
1480 POKE i+1,BIN 00000001
1490 POKE i+2,BIN 00111110
1500 POKE i+3,BIN 01010010
1510 POKE i+4,BIN 00010010
1520 POKE i+5,BIN 00010010
1530 POKE i+6,BIN 00010010
1540 POKE i+7,BIN 00000000
1550 DEF PROC sageata
1560 LET i=SQR 29,a=ATN
     (dy/dx), b=ATN .4
1570 DRAW —i*COSE(a+b),
     —i*SINE(a+b)
1580 DRAW —4*SINE(a),4*
     COSE(a)
1590 DRAW i*COSE(a—b),i*
     SINE(a—b)
1600 >END PROC
1610 DEF PROC nord
1620 DRAW —2,—5: DRAW
     4,0
1630 DRAW —2,5: END PROC
1640 PAUSE 100
1650 PRINT FLASH 1;AT 9,0;
     "vo="
1660 INPUT "Introduceti vite-
     za!"; LINE v$
1670 FOR i=1 TO LEN v$
1680 IF CODE v$(i)<46 OR
     CODE v$(i)>57 THEN GO
     TO 1660
1690 IF CODE v$(i)=47 THEN
     GO TO 1660
1700 NEXT i
1710 LET vo=VAL v$
1720 IF vo=0 THEN PRINT
     #0; "Electronul este in re-
     paus!"
1730 IF vo=0 THEN PAUSE
     400
1740 IF vo=0 THEN GO TO
     1660
1750 IF vo<0 OR vo>3 THEN
     PRINT #0"Incercati cu vo
     ELSE [0,3]"
1760 >IF vo<0 OR vo>3 THEN
     PAUSE 400
1770 IF vo<0 OR vo>3 THEN
     GO TO 1660
1780 BEEP .5,40
1790 PRINT FLASH 0;AT 9,0;
```

```
     "vo="; USING "0.00";
     vo; "ua"
1800 PAUSE 100
1810 PRINT FLASH 1;AT 9,20;
     "ALTER ="
1820 INPUT "Intruduceti
     ALTER in rad !"; LINE u$
1830 IF CODE u$=167 THEN
     GO TO 1880
1840 FOR i=1 TO LEN u$
1850 IF CODE u$(i)<46 OR
     CODE u$(i)>57 THEN
     GO TO 1820
1860 IF CODE u$(i)=47 THEN
     GO TO 1820
1870 NEXT i
1880 LET u=VAL u$
1890 >IF u<0 OR u>PI/2
     THEN PRINT #0; "In-
     cercati cu ALTER ELSE
     [0, DPOKE/2]"
1900 IF u<0 OR u>PI/2 THEN
     PAUSE 400
1910 IF u<0 OR u>PI/2 THEN
     GO TO 1820
1920 BEEP .5,40
1930 PRINT FLASH 0;AT 9,20;
     "ALTER ="; USING
     "0,00";u; "rad"
1940 PRINT AT 10,20; "AL-
     TER ="; USING "00.0";
     180*u/PI;" grd"
1950 PAUSE 100
1960 PLOT 100,20
1970 LET dx=vo*10*COS u,
     dy=vo*10*SIN u
1980 DRAW dx,dy
1990 IF dx<>0 THEN PROC
     sageata
2000 IF dx=0 AND dy>0 THEN
     PROC nord
2010 >IF u<=PI/2 AND u>
     PI/3 THEN PLOT 80,46;
     "vo"
2020 IF u<=PI/2 AND u>PI/3
     THEN PLOT 80,48: DRAW
     15,0: DRAW -5,2:
     DRAW 0,-4: DRAW 5,2
2030 IF u<=PI/3 AND u>PI/6
     THEN PLOT 90,46;"vo"
2040 IF u<=PI/3 AND u>PI/6
     THEN PLOT 90,48: DRAW
     15,0: DRAW -5,2: DRAW
     0,-4: DRAW 5,2
2050 IF u<=PI/6 AND u>=0
     THEN PLOT 100,46; "vo"
2060 IF u<=PI/6 AND u>=0
     THEN PLOT 100,48:
     DRAW 15,0: DRAW -5,2:
     DRAW 0,-4: DRAW 5,2
2070 PAUSE 0
2080 DEF PROC elice
2090 FOR a=0 TO 100 STEP .3
2100 LET x=100+a*vo*
     COSE(u)+7*SINE(u)*
     COSE (a)
2110 LET y=110+17*vo*
     SINE(u)*SINE(a)
2120 >IF a=0 THEN PLOT x,y
2130 IF a>0 AND x<=230
     THEN DRAW (x-PEEK
     23677), (y-PEEK 23678)
2140 NEXT a
2150 END PROC
2160 DEF PROC cerc
2170 FOR a=0 TO 6.4 STEP .3
2180 LET x=100+7*vo*
     COSE(a)
2190 LET y=110+17*vo*
     SINE(a)
2200 IF a=0 THEN PLOT x,y
2210 IF a>0 THEN DRAW (x-
     PEEK 23677), (y-PEEK
     23678)
2220 NEXT a
2230 END PROC
2240 IF u<PI/2 THEN PROC
     elice
```

```
2250 IF u=PI/2 THEN PROC
     cerc
2260 PAUSE 100
2270 IFu>0ANDu<PI/2THEN
     PRINT #0; "Traiectorie
     elicoidala !"
2280>IF u=PI/2 THEN PRINT
     #0; "Traiectorie circulara!"
2290 IF u=0 THEN PRINT
     #0; "Traiectorie rectilinie !"
2300 LET t=1
2310 PAUSE 0
2320 FOR i=1 TO 176
2330 SCROLL 7: NEXT i
2340 CLS
2350 GO TO 580
2360 SAVE "Elice" LINE 10
```

3.3. CIRCUIT RLC SERIE („RLC SERIE")

Se tipărește sub forma unui tabel răspunsul la 20 întrebări legate de circuitul RLC serie, fomat din elemente ideale. Instrucțiunea INPUT cere introducerea unor mărimi fizice necesare efectuării calculelor. Acest program permite rezolvarea unor probleme care se găsesc în manualul de clasa a XI-a, la sfîrșitul capitolului intitulat „Curentul alternativ", dînd răspuns la un număr mult mai mare de întrebări decît cele din manual.

Cu ajutorul mărimilor calculate se reprezintă diagrama fazorială a circuitului RLC serie, graficul tensiunii și intensității, ținîndu-se seama de defazajul respectiv.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 DATA 127,39,56,55,32,76,
   72,67,67,32,67,46,71,79,73,
   65
90 CSIZE 16,24
100 PRINT FLASH 1;AT 3,5;
   "READY"
110 PAUSE 0: CLS
120 CSIZE 8,16
130 CIRCLE 20,100,2: PLOT
   22,100
140 DRAW 28,0: DRAW 0,-2
150 DRAW 30,0: DRAW 0,4
160 DRAW -30,0: DRAW 0,
   -2
170 PLOT 60,90;"R"
180 PAUSE 50
190 PLOT 80,100: DRAW 30,0
200>FOR i=1 TO 10
210 DRAW 5,0,-PI: NEXT i
220 PLOT 130,90;"L"
230 PAUSE 50
240 PLOT 160,100: DRAW
   35,0
250 PLOT 195,95: DRAW 0,10
260 PLOT 200,95: DRAW 0,10
270 PLOT 200,100: DRAW
   28,0
280 CIRCLE 230, 100,2: PLOT
   194,90;"C"
```

```
290 PAUSE 100
300 FOR i=1 TO 110
310 SCROLL 6: NEXT i
320 LET a$="CIRCUIT"
330 FOR i=1 TO 7
340 BEEP .1,RND *30
350 PLOT 45+i *20,120 ;a$(i)
360 NEXT i
370 LET b$="RLC SERIE"
380 FOR i=1 TO 9
390 BEEP .1,RND *30
400 PLOT 75+i *10,100 ;b$(i)
410 >NEXT i
420 PAUSE 100
430 FOR i=1 TO 16
440 BEEP .1,RND *30
450 PLOT 40+i *10,80 ;z$(i)
460 NEXT i
470 PAUSE 50
480 FOR i=1 TO 6
490 BEEP .1,RND *30
500 PLOT 40,156-i *16 ;" *"
510 NEXT i
520 IF CODE z$(13)< >71
    THEN NEW
530 FOR i=1 TO 17
540 BEEP .1,RND *30
550 PLOT 40+i *10,60 ;" *"
560 NEXT i
570 FOR i=1 TO 5
580 BEEP .1,RND *30
590 PLOT 210,60+i *16 ;" *"
600 NEXT i
610 FOR i=1 TO 16
620 >BEEP .1,RND *30
630 PLOT 210-i *10,140 ;" *"
640 NEXT i
650 PAUSE 50: PLOT 38,142
660 DRAW 0,-100: DRAW
    182,0
670 DRAW 0,100: DRAW
    -182,0
680 PAUSE 100
690 BEEP .4,19: BEEP .2,23
700 BEEP .4,28: BEEP .2,26
710 BEEP .4,24: BEEP .2,23
720 BEEP .4,21: BEEP .2,23
730 BEEP .4,24: BEEP .2,26
740 BEEP .4,23: BEEP .2,21
750 BEEP .2,21: BEEP .2,19
760 BEEP .2,23: BEEP .4,26
770 BEEP .2,26
780 FOR i=1 TO 175
790 SCROLL 7
800 NEXT i
810 CLS
820 >PRINT AT 3,3; "Acest
    program raspunde la un nu-
    mar de 20 intrebari legate
    de circuitul RLC serie."
830 PRINT'
840 PRINT TAB 6; "Apasati
    orice tasta !"
850 PAUSE 0: CLS
860 PRINT AT 2.4; "Utilizati
    acest program pentru rezol-
    varea urmatoarelor proble-
    me :"
870 PRINT TAB 12; "XI,30,4"
880 PRINT TAB 12; "XI,30,5"
890 PRINT TAB 12;"XI,32,13"
900 PRINT
910 PRINT TAB 6; "Apasați
    orice tasta !"
920 PAUSE 0: CLS
930 >PRINT AT 4,2; "Intro-
    duceti tensiunea efectiva
    aplicata la bornele circui-
    tului (in V)"
940 INPUT ; LINE u$
950 FOR i=1 TO LEN u$
960 IF CODE u$(i)<46 OR
    CODE u$(i) >57 THEN GO
    TO 940
970 IF CODE U$ (i)=47 THEN
    GO ; TO 940
980 NEXT i
990 LET u=VAL u$
```

```
1000 CLS
1010 PRINT AT 5,0; "Introduceti frecventa curentului alternativ(in Hz)"
1020 INPUT LINE f$
1030 FOR i=1 TO LEN f$
1040 IF CODE f$(i)<46 OR CODE f$(i)>57 THEN GO TO 1020
1050 IF CODE f$(i)=47 THEN GO TO 1020
1060 >NEXT i
1070 LET f=VAL f$
1080 CLS
1090 IF f=0 THEN GO TO 930
1100 PRINT AT 5,0; "Introduceti rezistenta electrica (in Ohmi)"
1110 INPUT LINE R$
1120 FOR i=1 TO LEN R$
1130 IF CODE R$(i)<46 OR CODE R$(i)>57 THEN GO TO 1110
1140 IF CODE R$(i)=47 THEN GO TO 1110
1150 NEXT i
1160 LET R=VAL R$
1170 CLS
1180 IF R=0 THEN PRINT AT 5,4;"Nu analizez circuit fara rezistenta!"
1190 IF R=0 THEN GO TO 920
1200 PRINT AT 5,1; "Introduceti inductanta (in H)"
1210 >INPUT LINE L$
1220 FOR i=1 TO LEN L$
1230 IF CODE L$(i)<46 OR CODE L$(i)>57 THEN GO TO 1210
1240 IF CODE L$=47 THEN GO TO 1210
1250 NEXT i
1260 LET L=VAL L$
1270 CLS
1280 IF L=0 THEN PRINT AT 5,4; "Nu analizez circuit fara inductanta!"
1290 IF L=0 THEN GO TO 920
1300 PRINT AT 5,3; "Introduceti capacitatea electrica (in F)"
1310 INPUT LINE c$
1320 FOR i=1 TO LEN C$
1330 IF CODE C$(i)<46 OR CODE C$(i)>57 THEN GO TO 1310
1340 IF CODE C$(i)=47 THEN GO TO 1310
1350 >NEXT i
1360 LET C=VAL C$
1370 CLS
1380 IF C=0 THEN PRINT AT 5,4; "Nu analizez circuit fara capacitate!"
1390 IF C=0 THEN GO TO 920
1400 LET XL=2*PI*f*L
1410 LET XC=1/(2*PI*f*C)
1420 LET Z=SQR (r^2+(ABS (XL-XC))^2)
1430 LET I=U/Z
1440 LET UR=I*R
1450 LET UL=I*XL
1460 LET UC=I*XC
1470 LET fi=180/PI*(ATN (XL-XC)/R))
1480 LET f0=1/(2*PI*SQR (L*C))
1490 LET Ir=U/R
1500 LET UR0=Ir*R
1510 LET UL0=Ir*2*PI*f0*L
1520 LET UC0=Ir/(2*PI*f0*C)
1530 >LET Q=UL0/U
1540 LET Z0=SQR (L/C)
1550 LET fp=COS (PI*fi/180)
1560 LET P=U*I*fp
```

```
1570 LET Pr=U*I*SIN
     (PI*fi/180)
1580 LET S=SQR ((ABS P)^2+
     (ABS Pr)^2)
1590 PRINT "1) Reactanta in-
     ductiva :"; TAB 10; "XL=
     ="; XL; "Ohmi"; TAB
     0; ". . . . . . . . . . .
     . . . . . . ."
1600 PRINT "2) Reactanta ca-
     pacitiva :"; TAB 10;
     "XC=";XC; "Ohmi";
     TAB 0; ". . . . . . . .
     . . . . . . . ."
1610 PRINT "3) Impedanta :";
     TAB 10;"Z="; Z; "Ohmi"
     ; TAB 0; ". . . . . . .
     . . . . . . . . . . .
     . . ."
1620 >PRINT "4) Intensita-
     tea :"; TAB 10; "I="; I;
     "A"; TAB 0; ". . . . .
     . . . . . . . . . . .
     . . . . ."
1630 PRINT "5) Tensiunea :";
     TAB 10;" UR="; UR;
     "V"; TAB 0; ". . . . .
     . . . . . . . . . . .
     . ."
1640 PRINT "6) Tensiunea :";
     TAB 10; "UL="; UL;
     "V"; TAB 0; ". . . . .
     . . . . . . . . . . .
     . ."
1650 PRINT "7)Tensiunea :";
     TAB 10; "UC="; UC;
     "V"; TAB 0; ". . . . .
     . . . . . . . . . . .
     . ."
1660 PRINT "8) Defazajul :";
     TAB 10; "fi="; fi;
     "grade"; TAB 0; ". . . .
     . . . . . . . . . . .
     . . . ."
1670 >PRINT "9) Frecventa de
     rezonanta:";TAB10;"f0=";
     "f0; "Hz"; TAB 0; ". . .
     . . . . . . . . . . ."
1680 PRINT "10) Intensitatea
     la rezonanta :"; TAB 10;
     "Ir="; Ir; "A"; TAB 0;
     ". . . . . . . . . . . . .
     . . . . . . . . ."
1690 PRINT "11) Tensiunea la
     rezonanta :"; TAB 10;
     "UR0="; UR0; "V";
     TAB 0; ". . . . . . . .
     . . . . . . . ."
1700 PRINT "12) Tensiunea la
     rezonanta : "; TAB 10;
     "UL0="; UL0; "V"; TAB
     0; ". . . . . . . . . . .
     . . . . . . . ."
1710 PRINT "13) Tensiunea la
     rezonanta :"; TAB 10;
     "UC0="; UC0; "V";
     TAB 0; ". . . . . . .
     . . . . . . . . ."
1720 >PRINT "14) Factorul de
     calitate :"; TAB 10; "Q=";
     Q; TAB 0; ". . . . . .
     . . . . ."
1730 PRINT "15) Impedanta ca-
     racteristica :"; TAB 10;
     "Z0="; Z0; "Ohmi";
     TAB 0; ". . . . . . .
     . . . . . . . ."
1740 PRINT "16) Factorul de
     putere :"; TAB 10; "fp=";
     fp; TAB 0; ". . . . . .
     . . . . ."
1750 PRINT "17) Puterea ac-
     tiva :"; TAB 10; "P=";
     P; "W"; TAB 0; ". . .
     . . . . ."
1760 PRINT "18) Puterea reac-
     tiva :"; TAB 10; "Pr=";
```

```
Pr: "VAR"; TAB 0; ". .
. . . . . . . ."
1770 >PRINT "19) Puterea apa-
renta:"; TAB 10; "S=";
S; "VA"; TAB 0; ". . . .
. . . . . . . . . . . . .
. . . ."
1780 IF XL>XC THEN PRINT
"20) Efectul inductiv este
predominant"
1790 IF XC>XL THEN PRINT
"20) Efectul capacitiv este
predominant."
1800 IF XL=XC THEN PRINT
"20) In conditiile problemei,
apare rezonanta tensiuni-
lor."
1810 PAUSE 0: CLS
1820 PRINT TAB 6: "DIA-
GRAMA FAZORIALA"
1830 LET m=UL+UC
1840 IF UR>=m THEN LET
ULs=UL*200/UR
1850 IF UR>=m THEN LET
UCs=UC*200/UR
1860 IF UR>=m THEN LET
URs=200
1870 >IF UR<m THEN LET
ULs=130*UL/(UL+UC)
1880 IF UR<m THEN LET
UCs=UC*130/(UL+UC)
1890 IF UR<m THEN LET
URs=130*UR/(UL+UC)
1900 LET o=10+UCs
1910 DEF PROC sageata
1920 LET i=SQR 29, a=ATN
(dy/dx), b=ATN .4
1930 DRAW -i*COSE (a+b),
-i*SINE (a+b)
1940 DRAW -4*SINE (a),
4*COSE (a)
1950 DRAW i*COSE (a-b),
i*SINE (a-b)
1960 END PROC
1970 DEF PROC nord
1980 DRAW -2,-5: DRAW 4,0
1990 DRAW -2,5
2000 END PROC
2010 DEF PROC sud
2020 DRAW -2,5: DRAW 4,0
2030 >DRAW -2,-5: END
PROC
2040 DEF PROC est
2050 DRAW -5,2: DRAW 0,-4
2060 DRAW 5,2: END PROC
2070 PLOT 30,o: DRAW 225,0
2080 PROC est
2090 PLOT 240,o+20; "I"
2100 PAUSE 100
2110 PLOT 30+URs,o: PROC
est
2120 IF ULs>=UCs THEN
PLOT 34+URs,o-2;
"UR"
2130 IF ULs<UCs THEN PLOT
34+URs,o+20; "UR"
2140 PAUSE 100
2150 PLOT 30,o: DRAW 0, ULs
2160 PROC nord
2170 PLOT 5,o+ULs; "UL"
2180 PAUSE 100
2190 PLOT 30,o: DRAW 0,
-UCs
2200 PROC sud
2210 PLOT 5,o-UCs+8; "UC"
2220 PAUSE 100
2230 >PLOT 30,o: LET dx=
URs, dy=ULs-UCs
2240 DRAW dx, dy
2250 IF dx<>0 THEN PROC
sageata
2260 IF dx=0 AND dy>0
THEN PROC nord
2270 IF dx=0 AND dy<0 THEN
PROC sud
2280 IF ULs>=UCs THEN
PLOT 34+URs,o+
(ULs-UCs)+20; "U"
```

```
2290 IF ULs<UCs THEN PLOT
     34+URs,o-(UCs-ULs)
     -4; "U"
2300 PAUSE 100
2310 IF ULs>UCs THEN
     PRINT #0; "Efectul in-
     ductiv predomina."
2320 IF ULs=UCs THEN
     PRINT #0;"Rezonanta
     tensiunilor."
2330 IF ULs<UCs THEN
     PRINT #0; "Efectul ca-
     pacitiv predomina."
2340 PAUSE 0: CLS
2350>PRINT AT 0,12; "GRA-
     FICUL"
2360 PRINT AT 1,3; "TENSI-
     UNII SI INTENSITATII"
2370 PLOT 30,0: DRAW 0,140
2380 PROC nord
2390 PLOT 0,140; "u,i": PLOT
     15,78; "0"
2400 PAUSE 50
2410 PLOT 30,70: DRAW
     220,0
2420 PROC est: PLOT 230,65;
     "t"
2430 PAUSE 50
2440 FOR x=0 TO 179
2450 LET u=70+60*SINE
     (PI/30*x)
2460 LET u1=70+60*
     SINE(PI/30*(x+1))
2470 LET i=70+40*SINE
     (PI/30*x-fi*PI/180)
2480 LET i1=70+40*SINE
     (PI/30*(x+1)-fi*PI/
     180)
2490 PLOT x+30,u: DRAW 1,
     u1-u
2500 PLOT x+30,i: DRAW 1,
     i1-i
2510 NEXT x
2520>GO TO 920
2530 SAVE "RLC serie" LINE
     10
```

3.4. PUTEREA ÎN CURENT ALTERNATIV („PUTEREA")

Folosind un singur sistem de axe de coordonate se reprezintă în funcție de timp următoarele mărimi fizice: tensiunea momentană, intensitatea momentană, puterea momentană și puterea medie (puterea activă). În funcție de dorința utilizatorului se pot introduce diferite defazaje între intensitate și tensiune, cu condiția ca să nu se iasă din intervalul −PI/3 și PI/3. Dacă nu se respectă intervalul respectiv, calculatorul refuză execuția graficului.

```
10 BORDER 2; PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1; AT
   3,5; "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="PUTEREA"
130 FOR i=1 TO 7
```

```
140 BEEP .1,RND *30
150 PLOT 45+i *20,120 ; a$(i)
160 NEXT i
170 LET b$="INSTANTA-
    NEE"
180 FOR i=1 TO 11
190 BEEP .1,RND *30
200 PLOT 65+i *10,100 ;$(i)
210 NEXT i
220 >PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND *30
250 PLOT 40+i *10,80 ;z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND *30
300 PLOT 40,156-i *16 ;" *"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND *30
340 PLOT 40+i *10,60 ;" *"
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND *30
380 PLOT 210,60+i *16 ;" *"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210-i *10,140 ; " *"
430 NEXT i
440 >PAUSE 50 : PLOT 38,142
450 DRAW 0,-100 : DRAW
    182,0
460 DRAW 0,100 : DRAW
    -182,0
470 PAUSE 100
480 DATA 127,39,56,55,32,76,72
    67,67,32,67,46,71,79,73,65
490 BEEP .4,19 : BEEP .2,23
500 BEEP .4,28 : BEEP .2,26
510 BEEP .4,24 : BEEP .2,23
520 BEEP .4,21 : BEEP .2,23
530 BEEP .4,24 : BEEP .2,26
540 BEEP .4,23 : BEEP .2,21
550 BEEP .2,21 : BEEP .2,19
560 BEEP .2,23 : BEEP .4,26
570 BEEP .2,26
580 FOR i=1 TO 175
590 SCROLL 7
600 NEXT i
610 IF CODE z$(13)< >71
    THEN NEW
620 CLS
630 KEYWORDS 0
640 >LET i=USR "o"
650 POKE i+0,BIN 00000000
660 POKE i+1,BIN 00000000
670 POKE i+2,BIN 00100100
680 POKE i+3,BIN 01000010
690 POKE i+4,BIN 01000010
700 POKE i+5,BIN 01011010
710 POKE i+6,BIN 00100100
720 POKE i+7,BIN 00000000
730 LET i=USR "f"
740 POKE i+0,BIN 00000000
750 POKE i+1,BIN 00001100
760 POKE i+2,BIN 01010010
770 POKE i+3,BIN 01010010
780 POKE i+4,BIN 01010010
790 POKE i+5,BIN 00111100
800 POKE i+6,BIN 00010000
810 POKE i+7,BIN 00010000
820 PRINT AT 1,14; "Daca"
830 PRINT AT 2,11 ; "u=Um.
    sin ONt"
840 PRINT AT 3.15; "si"
850 >PRINT AT 4,9 ; "i=Im.sin
    (ONt+FILL)"
860 PRINT AT 6,3 ; "puterea
    instantanee este :"
870 PRINT AT 8,2 ; "p=u.i=
    Um.sin ON t.Im.sin (ON t+
    FILL)"
880 PAUSE 0
890 FOR i=1 TO 175
900 SCROLL 7
910 NEXT i
```

```
920 DEF PROC sun
930 FOR i=1 TO 3
940 BEEP .2,30 : BEEP .2,35 :
    BEEP .2,40
950 NEXT i
960 END PROC
970 CLS
980 PLOT 2,0 : DRAW 0,165
990 DRAW 2,-5 : DRAW
    -4,0 : DRAW 2,5
1000 PAUSE 100
1010 PRINT FLASH 1; AT
     0,1 ; "u"
1020 >PROC sun
1030 PRINT FLASH 0 ; AT 0,1 ;
     "u"
1040 PAUSE 50
1050 PRINT FLASH 1 ; AT 0,2 ;
     ",i"
1060 PROC sun
1070 PRINT FLASH 0 ;AT 0,2 ;
     ",i"
1080 PAUSE 50
1090 PRINT FLASH 1 ;AT 0,4 ;
     ",p"
1100 PROC sun
1110 PRINT FLASH 0 ; AT 0,4 ;
     ",p"
1120 PAUSE 100
1130 PLOT 0,40 : DRAW 255,0
1140 DRAW -5,2 : DRAW 0,
     -4 : DRAW 5,2
1150 PAUSE 100
1160 PRINT FLASH 1 ; AT
     7,31 ; "t"
1170 PROC sun
1180 PRINT FLASH 0 ; AT
     7,31 ; "t"
1190 PAUSE 200
1200 INPUT "Introduceti defa-
     zajul!" ; LINE f$
1210 FOR i=1 TO LEN f$
1220 >IF CODE f$(i)<45 OR
     CODE f$(i)>57 THEN
     GO TO 1200
1230 IF CODE f$ (i)=47 THEN
     GO TO 1200
1240 NEXT i
1250 LET fi=VAL f$
1260 IF fi>60 OR fi<-60
     THEN PRINT #1; "De-
     fazajul apartine [-60,60]
     grd." : PAUSE 400: GO
     TO 1200
1270 IF fi<0 THEN PRINT
     #1; AT 0,0 ;" Intensi-
     tatea este in urma tensi-
     unii cu FILL=" ; fi ;
     "grd"
1280 IF fi>0 THEN PRINT
     #1; AT 0,0 ; "Intensi-
     tatea este defazata ina-
     intea tensiunii cu FILL=
     " ;fi ;"grd"
1290 IF fi=0 THEN PRINT
     #1 ;AT 0,0 ; "Intensitatea
     si tensiunea sint in faza,
     FILL=0 grd."
1300 >FOR t=0 TO 244 STEP
     2
1310 LET u=40+16 * SINE ((t/
     123 * PI))
1320 LET u1=40+16 * SINE
     (((t+2)/123 * PI))
1330 LET i=40+8 * SINE
     ((t/123 * PI+fi * PI/180))
1340 LET i1=40+8 * SINE
     (((t+2)/123 * PI+fi * PI/
     180))
1350 PLOT t+2,u : DRAW 2,
     u1-u
1360 PLOT t+2,i : DRAW 2,
     i1-i
1370 PLOT t+2, (u-40) *
     (i-40)+40
1380 DRAW 2, (u1-40) *
     (i1-40)-(u-40) * (i-40)
```

```
1390 NEXT t
1400 PAUSE 100
1410 PLOT 6,60+64 *COSE
     (fi *PI/180) ; "P"
1420 PLOT 2,40+64 *COSE
     (fi *PI/180) : DRAW 246,0
1430 PAUSE 200
1440>IF fi<0 THEN PRINT
     #1 ; AT 0,0 ; "Efectul in-
     ductiv este predominant !"
1450 IF fi>0 THEN PRINT
     #1 ; AT 0,0 ; "Efectul ca-
     pacitiv este predominant !"
1460 IF fi=0 THEN PRINT
     #1 ; AT 0,0 ; "Aceasta situ-
     atie apare la rezonanta sau
     in cazul rezistorului ideal !"
1470 PAUSE 200
1480 IF fi=0 THEN PRINT
     #1 ; AT 0,0 ; "Puterea in-
     stantanee are numai valori
     pozitive !"
1490 INPUT "Mai doriti exem-
     ple ? (d/n)" ; s$
1500>IF s$="d" THEN GO
     TO 970
1510 IF s$="n" THEN GO
     TO 1530
1520 IF s$<>"n" OR s$<>
     "d" THEN GO TO 1490
1530 CLS
1540 PRINT AT 0,1 ; "Retineti
     urmatoarele relatii :"
1550 PRINT AT 2,11 ; "P=U.I.
     cos FILL"
1560 PRINT AT 3,5 ; "P-puterea
     activa ; <P>=W"
1570 PRINT AT 5,10 ; "Pr=
     U.I.sin FILL"
1580 PRINT AT 6,2 ; "Pr-pute-
     rea reactiva ; <Pr>=
     VAR"
1590 PRINT AT 8,13 ; "S=U.I"
1600 PRINT AT 9,3 ; "S-puterea
     aparenta ; <S>=VA"
1610 PAUSE 0 : STOP
1620 SAVE "Puterea" LINE 10
```

4. ELEMENTE NELINIARE DE CIRCUIT

4.1. REDRESAREA MONOALTERNANȚĂ („MONO")

Sînt prezentate două scheme electrice de redresoare monoalternanță cu ajutorul diodei cu vid, apoi cu diodă semiconductoare. Se reprezintă grafic tensiunea ce urmează a fi redresată, tensiunea redresată, primele două componente ale dezvoltării în serie Fourier, precum și expresiile matematice ale acestora.

Graficul sumei celor două componente se poate compara cu graficul tensiunii redresate, pentru a aprecia măsura în care tensiunea redresată este aproximată doar de primii doi termeni din seria Fourier.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1; AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="REDRESOR"
130 FOR i=1 TO 8
140 BEEP .1,RND*30
150 PLOT 35+i*20,120; a$(i)
160 NEXT i
170 LET b$="MONOALTER-
   NANTA"
180 FOR i=1 TO 14
190 BEEP .1,RND*30
200 PLOT  50+i*10,100; b$
   (i)
210 NEXT i
220 >PAUSE 100
230 FOR i=1  TO 16
240 BEEP .1,RND*30
250 PLOT  40+i*10,80; z$
   (i)
260 NEXT i
270 PAUSE 50
280 FOR i=1  TO 6
290 BEEP .1,RND*30
300 PLOT 40,156-i*16; "*"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND*30
340 PLOT 40+i*10,60; "*"
```

```
350 NEXT i
360 FOR i=1 TO 5
370 BEEP 1,RND *30
380 PLOT 210,60+i *16 ;" *"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210-i *10,140 ; " *"
430 NEXT i
440>PAUSE 50 : PLOT 38,142
450 DRAW 0,-100 : DRAW
    182,0
460 DRAW 0,100 : DRAW
    -182,0
470 PAUSE 100
480 BEEP .4,19 : BEEP .2,23
490 BEEP .4,28 : BEEP .2,26
500 BEEP .4,24 : BEEP .2,23
510 BEEP .4,21 : BEEP .2,23
520 BEEP .4,24 : BEEP .2,26
530 BEEP .4,23 : BEEP .2,21
540 BEEP .2,21 : BEEP .2,19
550 BEEP .2;23 : BEEP .4,26
560 BEEP .2,26
570 IF CODE z$(13)<>71
    THEN NEW
580 CSIZE 0
590 DATA 127,39,56,55,32,76,72
    67,67,32,67,46,71,79,73,65
600 FOR i=1 TO 175
610 SCROLL 7
620 NEXT i
630 CLS
640>DEF PROC est
650 DRAW -5,2 : DRAW 0,
    -4 : DRAW 5,2
660 END PROC
670 DEF PROC nord
680 DRAW -2,-5 : DRAW
    4,0 : DRAW -2,5
690 END PROC
700 DEF PROC vest
710 DRAW 5,2 : DRAW 0,-4 :
    DRAW -5,2
720 END PROC
730 DEF PROC sud
740 DRAW 2,5 : DRAW -4,0 ;
    DRAW 2,-5
750 END PROC
760 CIRCLE 10,140,2 : PLOT
    10,142
770 DRAW 0,18 : DRAW 20,0 :
    DRAW 0,-5
780 FOR i=1 TO 10
790 DRAW 0,-5,-PI : NEXT
    i
800>DRAW 0,-5 : DRAW
    -20,0
810 DRAW 0,18 : CIRCLE 10,
    120,2
820 PAUSE 100
830 PLOT 40,160 : DRAW 0,
    -60
840 PAUSE 100
850 PLOT 50,170 : DRAW 0,
    -5
860 FOR i=1 TO 7
870 DRAW 0,-5,PI : NEXT i
880 DRAW 0,-5 : PAUSE 100
890 PLOT 50,110 : DRAW 0,
    -5
900 DRAW 0,-5,PI : DRAW
    0, -5,PI : DRAW 0,-5
910 PAUSE 50 : PLOT 25,175 ;
    "Tr"
920 PAUSE 50 : PLOT 25,155
930 DRAW 0,-50 : PROC
    sud
940 PAUSE 50 : PLOT 8, 135 ;
    "u1"
950 PAUSE 50 : PLOT 55,165
960 DRAW 0,-35 : PROC sud
970 PAUSE 50 : PLOT 58,152 ;
    "u2"
980 PAUSE 50 : PLOT 55,105
990 DRAW 0,-10 : PROC sud
1000 PAUSE 50 : PLOT 58,105 ;
    "uf"
```

```
1010 >PAUSE 0
1020 CIRCLE 110,150,15
1030 PLOT 105,160: DRAW
     10,0
1040 PLOT 110,160: DRAW
     0,10
1050 PLOT 100,125: DRAW
     0,13
1060 DRAW 20,0, -PI/1.5
1070 PLOT 105,110: DRAW
     0,26
1080 DRAW 10,0, -PI/1.5:
     DRAW 0,-46
1090 PAUSE 0
1100 PLOT 50,170: DRAW 60,0
1110 PAUSE 50
1120 PLOT 50,125: DRAW 15,0
1130 DRAW 0,3: DRAW 20,0
1140 DRAW 0, -6: DRAW
     -20,0
1150 DRAW 0,3: PLOT 85,125
1160 DRAW 15,0: PAUSE 50
1170 PLOT 50,110: DRAW
     55,0
1180 PLOT 50,90: DRAW 65,0:
     PAUSE 50
1190 PLOT 70,120; "Rs": PA-
     USE 50
1200 PLOT 85,135: DRAW
     -20,0
1210 >PROC vest
1220 PAUSE 50
1230 PLOT 75,145; "u"
1240 PLOT 55,124; "-": PLOT
     88,124; "+"
1250 PAUSE 500
1260 PLOT 140,110: DRAW
     0,65
1270 PROC nord
1280 PLOT 155,175; "u2":
     PAUSE 50
1290 PLOT 135,140: DRAW
     120,0
1300 PROC est
1310 PLOT 240,138; "t"
1320 PAUSE 50: FOR x=0
     TO 99
1330 LET y=140+35 * SINE
     ((PI * x/20))
1340 LET y1=140+35 * SINE
     ((PI * (x+1)/20))
1350 PLOT 140+x,y: DRAW
     1,y1-y
1360 NEXT x
1370 PAUSE 100: PLOT 140,70
1380 DRAW 0,35: PROC nord
1390 PLOT 130,105; "u"
1400 >PAUSE 50: FOR x=0
     TO 110 STEP 5
1410 PLOT 140+x,70: NEXT
     x
1420 PROC est
1430 PAUSE 50: PLOT 240,80;
     "t"
1440 PAUSE 50: FOR x=0 TO
     99
1450 LET y=30 * SINE ((PI *
     x/20))
1460 LET y1=30 * SINE ((PI *
     (X+1)/20))
1470 IF y>=0 THEN PLOT
     140+x, 70+y
1480 IF y1>=0 THEN DRAW
     1, y1-y
1490 IF y<=0 THEN PLOT
     140+x,70
1500 NEXT x
1510 PAUSE 50: PLOT 190,90
1520 DRAW 0,10: PROC nord
1530 PAUSE 50: PLOT 190,80
1540 DRAW 0, -10: PROC
     sud
1550 PAUSE 50: PLOT 186,89;
     "Um"
1560 PAUSE 500: PLOT 0,80;
     "u=U"
1570 PLOT 24,75; "=": PLOT
     32,80; "+u'+ ....."
```

```
1580 >KEYWORDS 0: LET
     i=USR "p"
1590 POKE i+0,BIN 00000000
1600 POKE i+1,BIN 00000001
1610 POKE i+2,BIN 00111110
1620 POKE i+3,BIN 01010010
1630 POKE i+4,BIN 00010010
1640 POKE i+5,BIN 00010010
1650 POKE i+6,BIN 00010010
1660 POKE i+7,BIN 00000000
1670 PAUSE 0: PLOT 0,60;
     "U"
1680 PLOT 8,55; "=": PLOT
     16,60;"=Um/DPOKE"
1690 PAUSE 500: PLOT 0,40;
     "u'="
1700 PLOT 24,35: DRAW 16,0
1710 PLOT 24,44; "Um":
     PLOT 25,34; "2"
1720 LET i=USR "o"
1730 POKE i+0,BIN 00000000
1740 POKE i+1,BIN 00000000
1750 POKE i+2,BIN 00100100
1760 POKE i+3,BIN 01000010
1770 POKE i+4,BIN 01000010
1780 >POKE i+5,BIN 01011010
1790 POKE i+6,BIN 00100100
1800 POKE i+7,BIN 00000000
1810 PLOT 40,40; "sin": PLOT
     70,40; "ON": PLOT
     80,40; "t"
1820 PAUSE 0: PLOT 140,10
1830 DRAW 0,45: PROC nord
1840 PAUSE 50: PLOT 135,30
1850 DRAW 120,0: PROC est
1860 PAUSE 50: PLOT 240,38;
     "t"
1870 PAUSE 50: PLOT 165,55;
     "U=“
1880 LET c=30/PI
1890 FOR x=0 TO 100:
     PAUSE 5          m
1900 PLOT 140+x,30+c
1910 NEXT x: PAUSE 50
1920 PLOT 123,60; "u'":
     PAUSE 50
1930 FOR x=0 TO 99
1940 LET y=30+15*SINE
     ((PI*x/20))
1950 LET y1=30+15*SINE
     ((PI*(x+1)/20))
1960 PLOT 140+x,y: DRAW
     1,y1-y
1970 NEXT x
1980 >PAUSE 500
1990 LET i=USR "g"
2000 POKE i+0,BIN 00000000
2010 POKE i+1,BIN 00000000
2020 POKE i+2,BIN 01000100
2030 POKE i+3,BIN 00101010
2040 POKE i+4,BIN 00010000
2050 POKE i+5,BIN 00010000
2060 POKE i+6,BIN 00010000
2070 POKE i+7,BIN 00000000
2080 PLOT 0,20; "GET=":
     PLOT 16,16: DRAW 40,0
2090 PLOT 16,25; "Um/2"
2100 PLOT 16,15; "Um/
     DPOKE"
2110 PLOT 56,20; "=1,57"
2120 PAUSE 400
2130 FOR x=14 TO 21
2140 FOR y=15 TO 31
2150 PRINT AT x,y; "  "
2160 NEXT y: NEXT x
2170 PAUSE 50
2180 PRINT AT 16,20; "GRA-
     FICUL"
2190 >PRINT AT 18,22; "SU-
     MEI"
2200 PRINT AT 20,18; "COM
     PONENTELOR"
2210 PAUSE 100
2220 FOR x=14 TO 21
2230 FOR y=16 TO 31
2240 PRINT AT x,y; "  "
2250 NEXT y: NEXT x
2260 PAUSE 50
```

```
2270 PLOT 140,10: DRAW
     0,45
2280 PROC nord
2290 PLOT 130,69; "U": PLOT
     138,65; "="
2300 PLOT 146,69; "+u'"
2310 PAUSE 50: PLOT 135,30
2320 DRAW 120,0: PROC est
2330 PAUSE 50: PLOT 240,39;
     "t"
2340 PAUSE 50
2350 FOR x=0 TO 100 STEP 5
2360 PLOT 140+x,40
2370 NEXT x
2380 PAUSE 50
2390 >FOR x=0 TO 99
2400 LET y=30+c+15 * SINE
     ((PI * /20))
2410 LET y1=30+c+15 *
     SINE((PI *(x+1)/20))
2420 PLOT 140+x,y: DRAW 1,
     y1-y
2430 NEXT x
2440 PAUSE 0
2450 FOR x=0 TO 10: FOR
     y=0 TO 15
2460 PRINT AT x,y; "  "
2470 NEXT y: NEXT x
2480 PRINT AT 2,5; "DIODA"
2490 PRINT AT 4,0; "SEMI-
     CONDUCTOARE"
2500 PRINT AT 6,1; "POATE
     INLOCUI"
2510 PRINT AT 8,1; "DIODA
     CU VID"
2520 PAUSE 400
2530 FOR x=0 TO 10: FOR
     y=0 TO 15
2540 PRINT AT x,y; "  "
2550 >NEXT y: NEXT x
2560 CIRCULE 10,140,2: PLOT
     10,142
2570 DRAW 0,18: DRAW 20,0:
     DRAW 0,-5
2580 FOR i=1 TO 10
2590 DRAW 0,-5,-PI: NEXT i
2600 DRAW 0,-5: DRAW
     -20,0
2610 DRAW 0,18: CIRCLE 10,
     120,2
2620 PAUSE 100
2630 PLOT 40,160: DRAW 0,
     -60
2640 PLOT 50,160: DRAW 0,
     -5
2650 FOR i=1 TO 10
2660 DRAW 0,-5,PI
2670 NEXT i
2680 DRAW 0,-5: DRAW
     60,0
2690 DRAW 0,20: DRAW -2,0
2700 DRAW 0,20: DRAW 4,0
2710 DRAW 0,-20: DRAW
     -2,0
2720 PLOT 50,160: DRAW 30,0
2730 DRAW 0,-5: DRAW 10,5
2740 DRAW -10,5: DRAW 0,
     -5
2750 >PLOT 90,165: DRAW
     0,-10
2760 PAUSE 50: PLOT 90, 160
2770 DRAW 20,0: DRAW 0,
     -20
2780 PAUSE 50: PLOT 25,175;
     "Tr"
2790 PAUSE 50: PLOT 25,155
2800 DRAW 0,-50: PROC sud
2810 PAUSE 50: PLOT 8,135;
     "u1"
2820 PAUSE 50: PLOT 55,155
2830 DRAW 0,-50: PROC sud
2840 PAUSE 50: PLOT 60,135;
     "u2"
2850 PAUSE 50; PLOT 113, 135;
     "Rs"
2860 PAUSE 50
2870 PLOT 111,150; "+"
```

```
2880 PLOT 111,119; "–"
2890 PAUSE 50: PLOT 105,155
2900 DRAW 0,–50: PROC sud
2910 PLOT 95,135; "u"
2920 PAUSE 0: STOP
2930 SAVE "Mono" LINE 10
```

4.2. REDRESAREA BIALTERNANȚĂ („BI")

Se execută schemele electrice de redresor bialternanță cu dublă diodă, cu două diode semiconductoare și cu patru diode semiconductoare (puntea redresoare). Se reprezintă grafic tensiunea alternativă ce urmează a fi redresată, tensiunea redresată, primele două componente ale dezvoltării în serie Fourier și diferența lor.

```
 10 BORDER 2: PAPER 6
 20 INK 1: CLS
 30 DIM z$(16)
 40 FOR i=1 TO 16
 50 READ d
 60 LET z$(i)=CHR$ d
 70 NEXT i
 80 CSIZE 16,24
 90 PRINT FLASH 1; AT 3,5;
    "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="REDRESOR"
130 FOR i=1 TO 8
140 BEEP .1,RND*30
150 PLOT 35+i*20,120; a$(i)
160 NEXT i
170 LET b$="BIALTERN-
    NANTA"
180 FOR i=1 TO 12
190 BEEP .1,RND*30
200 PLOT 60+i*10,100; b$(i)
210 NEXT i
220 >PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND*30
250 PLOT 40+i*10,80; z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND*30
300 PLOT 40,156–i*16; "*"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND*30
340 PLOT 40+i*10,60; "*"
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND*30
380 PLOT 210,60+i*16; "*"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND*30
420 PLOT 210–i*10,140; "*"
430 NEXT i
440 >PAUSE 50: PLOT 38,142:
    DRAW 0,–100
450 DRAW 182,0: DRAW 0,
    100: DRAW –182,0
460 PAUSE 100
470 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
480 BEEP .4,19: BEEP .2,23
490 BEEP .4,28: BEEP .2,26
500 BEEP .4,24: BEEP .2,23
510 BEEP .4,21: BEEP .2,23
520 BEEP .4,24: BEEP .2,26
```

```
530 BEEP .4,23: BEEP .2,21
540 BEEP .2,21: BEEP .2,19
550 BEEP .2,23: BEEP .4,26
560 BEEP .2,26
570 IF CODE z$(13)<>71
    THEN NEW
580 CSIZE 0
590 FOR i=1 TO 175
600 SCROLL 7
610 NEXT i
620>CLS
630 DEF PROC est
640 DRAW -5,2: DRAW 0,
    -4: DRAW 5,2
650 END PROC
660 DEF PROC nord
670 DRAW -2,-5: DRAW
    4,0: DRAW -2,5
680 END PROC
690 DEF PROC vest
700 DRAW 5,2: DRAW 0,-4:
    DRAW -5,2
710 END PROC
720 DEF PROC sud
730 DRAW 2,5: DRAW -4,0:
    DRAW 2,-5
740 END PROC
750 CIRCLE 10,140,2: PLOT
    10,142
760 DRAW 0,18: DRAW 15,0:
    DRAW 0,-5
770 FOR i=1 TO 10
780>DRAW 0,-5,-PI:
    NEXT i
790 DRAW 0,-5: DRAW
    -15,0
800 DRAW 0,18: CIRCLE 10,
    120,2
810 PAUSE 100
820 PLOT 35,160: DRAW 0,
    -60
830 PAUSE 100
840 PLOT 45,170: DRAW 0,
    -5
850 FOR i=1 TO 8
860 DRAW 0,-5,PI: NEXT i
870 DRAW 0,-5
880 PAUSE 100: PLOT 45,110
890 DRAW 0,-5: DRAW 0,
    -5,PI
900 DRAW 0,-5,PI: DRAW
    0,-5
910 PLOT 45,145: DRAW 10,0
920 PAUSE 100: PLOT 20,170;
    "Tr"
930 PAUSE 50: PLOT 20,155
940 DRAW 0,-50: PROC sud
950 PAUSE 50: PLOT 0,134;
    "u1"
960 PAUSE 50: PLOT 50,165
970 DRAW 0,-15: PROC sud
980 PAUSE 50: PLOT 50,140
990 DRAW 0,-15: PROC sud
1000>PAUSE 50: PLOT 51,168;
    "u2"
1010 PAUSE 50: PLOT 50,105
1020 DRAW 0,-10: PROC sud
1030 PAUSE 50: PLOT 55,104;
    "uf"
1040 PAUSE 0
1050 CIRCLE 110,130,15
1060 PLOT 105,110: DRAW
    0,6
1070 DRAW 10,0,-PI/1.5:
    DRAW 0,-26
1080 PLOT 85,115: DRAW 17,0
1090 DRAW 15,2,-PI/1.2
1100 PLOT 102,137: DRAW 6,0
1110 PLOT 112,137: DRAW
    6,0
1120 PLOT 105,150: DRAW 0,
    -13
1130 PLOT 115,170: DRAW 0,
    -33
1140 PAUSE 0
1150 PLOT 45,110: DRAW 60,0
1160 PLOT 45,90: DRAW 70,0
1170 PLOT 45,170: DRAW 70,0
```

```
1180 PLOT 45,120 : DRAW 45,0
1190 DRAW 0,30 : DRAW 15,0
1200 PLOT 55,148 : DRAW 0,−6
1210 >DRAW 20,0 : DRAW 0,6 :
     DRAW −20,0
1220 PLOT 75,145 : DRAW 10,0
1230 DRAW 0,−20 : DRAW 0,
     −10,PI
1240 PAUSE 50 : PLOT 60,140 ;
     "Rs"
1250 PAUSE 50
1260 PLOT 52,140 ; "−" : PLOT
     76,140 ; "+"
1270 PAUSE 50 : PLOT 75,155
1280 DRAW −20,0 : PROC vest
1290 PAUSE 50 : PLOT 75,160 ;
     "u"
1300 PAUSE 0
1310 PLOT 140,140 : DRAW 0,35
1320 PROC nord
1330 PAUSE 50 : PLOT 160,
     175 ; "u2"
1340 PAUSE 50 : PLOT 135,140
1350 DRAW 120,0 : PROC est
1360 PAUSE 50 : PLOT 240,
     139 ; "t"
1370 FOR x=0 TO 99
1380 LET y=140+35 * SINE
     ((PI * x/20))
1390 >LET y1=140+35 * SINE
     ((PI * (x+1)/20))
1400 PLOT 140+x,y : DRAW
     1,y1−y
1410 NEXT x
1420 PAUSE 0
1430 PLOT 140,70 : DRAW 0,35
1440 PROC nord
1450 PLOT 145,110 ; "u"
1460 PAUSE 50
1470 FOR x=0 TO 115 STEP 5
1480 PLOT 140+x,70 : NEXT x
1490 PROC est
1500 PLOT 240,80 ; "t"
1510 PAUSE 0 : FOR x=0 TO 99
1520 LET y=70+ABS (30 *
     SINE((PI * x/20)))
1530 LET y1=70+ABS (30 *
     SINE((PI * (x+1)/20)))
1540 PLOT 140+x,y : DRAW
     1,y1−y
1550 NEXT x
1560 PLOT 190,90 : DRAW 0,10
1570 PROC nord
1580 >PLOT 190,80 : DRAW
     0,−10
1590 PROC sud
1600 PAUSE 50 : PLOT 185,88 ;
     "Um"
1610 PAUSE 0
1620 PLOT 0,80 ; "u=U"
     PLOT 24,76 ; "="
1630 PLOT 32,80 ; "−u′− . .
     . . . ."
1640 PAUSE 300
1650 PLOT 0,60 ; "U" : PLOT
     8,56 ; "="
1660 KEYWORDS 0 : LET i=
     USR "p"
1670 POKE i+0, BIN 00000000
1680 POKE i+1,BIN 00000001
1690 POKE i+2,BIN 00111110
1700 POKE i+3,BIN 01010010
1710 POKE i+4,BIN 00010010
1720 POKE i+5,BIN 00010010
1730 POKE i+6,BIN 00010010
1740 POKE i+7,BIN 00000000
1750 PLOT 16,60 ; "=2Um/
     DPOKE"
1760 LET c=60/PI
1770 PAUSE 1000 : PLOT 140,10
1780 >DRAW 0,45 : PROC nord
1790 PLOT 135,30 : DRAW
     120,0
1800 PROC est
1810 PAUSE 50 : PLOT 240,39 ;
     "t"
1820 PAUSE 100 : PLOT 185,60 ;
     "U="
```

```
1830 PAUSE 100
1840 FOR x=0 TO 100 : PAUSE
     3
1850 PLOT 140+x,30+c
1860 NEXT x
1870 PAUSE 300
1880 PLOT 0,40 ; "u'="
1890 PLOT 24,35 : DRAW 24,0
1900 PLOT 24,44 ; "4Um"
1910 PLOT 24,34 ; "3 DPOKE"
1920 LET i=USR "o"
1930 POKE i+0,BIN 00000000
1940 POKE i+1,BIN 00000000
1950 POKE i+2,BIN 00100100
1960 POKE i+3,BIN 01000010
1970 POKE i+4,BIN 01000010
1980 POKE i+5,BIN 01011010
1990 POKE i+6,BIN 00100100
2000 >POKE i+7,BIN 00000000
2010 PLOT 48,40 ; "cos2" : PLOT
     83,40 ; "ON"
2020 PLOT 93,40 ; "t"
2030 PAUSE 200
2040 PLOT 145,64 ; "u'"
2050 FOR x=0 TO 99
2060 LET y=30+40/PI *COSE
     ((PI *x/10))
2070 LET y1=30+40/PI *COSE
     ((PI*(x+1)/10))
2080 PLOT 140+x,y : DRAW
     1,y1-y
2090 NEXT x
2100 PAUSE 200
2110 LET i=USR "g"
2120 POKE i+0,BIN 00000000
2130 POKE i+1,BIN 00000000
2140 POKE i+2,BIN 01000100
2150 POKE i+3,BIN 00101010
2160 POKE i+4,BIN 00010000
2170 POKE i+5,BIN 00010000
2180 POKE i+6,BIN 00010000
2190 >POKE i+7,BIN 00000000
2200 PLOT 2,20 ; "GET" :
     PLOT 10,20 ;"="
2210 PLOT 16,15 : DRAW 56,0
2220 PLOT 16,24 ; "4Um/3
     DPOKE"
2230 PLOT 20,14 ; "2Um/
     DPOKE"
2240 PLOT 72,20 ; "=0,67"
2250 PAUSE 200
2260 PAUSE 0
2270 FOR x=14 TO 21
2280 FOR y=16 TO 31
2290 PRINT AT x,y ; "  "
2300 NEXT y : NEXT x
2310 PAUSE 200
2320 PRINT AT 16,20 ; "GRA-
     FICUL"
2330 PRINT AT 18,19 ; "DI-
     FERENTEI"
2340 PRINT AT 20,18 ; "COM-
     PONENTELOR"
2350 PAUSE 300
2360 FOR x=14 TO 21
2370 FOR y=16 TO 31
2380 PRINT AT x,y ; "  "
2390 >NEXT y : NEXT x
2400 PAUSE 100
2410 PLOT 140,10 : DRAW 0,45
2420 PROC nord
2430 PLOT 110,64 ; "U" : PLOT
     118,60 ;  "="
2440 PLOT 126,64 ; "-u'"
2450 PAUSE 50 : PLOT 135,30
2460 DRAW 120,0 : PROC est
2470 PAUSE 50 : PLOT 240,29 ;
     "t"
2480 PAUSE 100
2490 FOR x=0 TO 100 STEP 5
2500 PLOT 140+x,30+c
2510 NEXT x
2520 PAUSE 100
2530 FOR x=0 TO 99
2540 LET y=30+c-40/PI *
     COSE ((PI *x/10))
2550 LET y1=30+c-40/PI *
     COSE((PI *(x+1)/10))
```

```
2560 PLOT 140+x,y: DRAW
     1,y1-y
2570 NEXT x
2580>PAUSE 0
2590 FOR x=0 TO 10: FOR
     y=0 TO 15
2600 PRINT AT x,y; "  "
2610 NEXT y: NEXT x
2620 PRINT AT 1,4; "DIO-
     DELE"
2630 PRINT AT 3,0; "SEMI-
     CONDUCTOARE"
2640 PRINT AT 5,2; "POT
     INLOCUI"
2650 PRINT AT 7,2; "DUBLA
     DIODA"
2660 PAUSE 300
2670 FOR x=0 TO 10: FOR
     y=0 TO 15
2680 PRINT AT x,y; "  "
2690 NEXT y: NEXT x
2700 PAUSE 50: CIRCLE 10,
     140,2
2710 PLOT 10,142: DRAW 0,18
2720 DRAW 15,0: DRAW 0,-5
2730 FOR i=1 TO 10
2740 DRAW 0,-5,-PI: NEXT
     i
2750 DRAW 0,-5: DRAW
     -15,0
2760 DRAW 0,18: CIRCLE 10,
     120,2
2770>PAUSE 50: PLOT 35, 160
2780 DRAW 0,-60
2790 PAUSE 50: PLOT 80,160
2800 DRAW -35,0: DRAW 0,
     -5
2810 FOR i=1 TO 10
2820 DRAW 0,-5,PI: NEXT i
2830 DRAW 0,-5: DRAW 35,0
2840 PLOT 45,130: DRAW 13,0
2850 PAUSE 50: PLOT 25,170;
     "Tr"
2860 PAUSE 100: PLOT 20,150
2870 DRAW 0,-40: PROC sud
2880 PLOT 0,134; "u1"
2890 PAUSE 100: PLOT 50,155
2900 DRAW 0,-20: PROC sud
2910 PLOT 50,125: DRAW 0,
     -20
2920 PROC sud
2930 PLOT 51,154; "u2"
2940 PLOT 80,165: DRAW 0,
     -10
2950 DRAW 10,5: DRAW -10,5
2960 PLOT 80,105: DRAW 0,
     -10
2970 DRAW 10,5: DRAW
     -10,5
2980 PLOT 90,165: DRAW 0,
     -10
2990>PLOT 90,105: DRAW 0,
     -10
3000 PLOT 90,160: DRAW 30,0
3010 DRAW 0,-60: DRAW
     -30,0
3020 PLOT 62,130: DRAW 8,0
3030 DRAW 0,2: DRAW 20,0
3040 DRAW 0,-4: DRAW
     -20,0: DRAW 0,2
3050 PLOT 90,130: DRAW 8,0
3060 PLOT 102,130: DRAW 18,0
3070 CIRCLE 60,130,2: CIRCLE
     100,130,2
3080 CIRCLE 120,130,2
3090 PLOT 95,170; "D1":
     PLOT 95,98; "D2"
3100 PAUSE 50: PLOT 72, 125;
     "Rs"
3110 PAUSE 100
3120 PLOT 56,124; "-": PLOT
     96,124; "+"
3130 PAUSE 50: PLOT 100,140
3140 DRAW -40,0: PROC vest
3150 PAUSE 50: PLOT 76,150;
     "u"
3160 PAUSE 0
3170>FOR x=0 TO 10
```

```
3180 FOR y=0 TO 15
3190 PRINT AT x,y; "  "
3200 NEXT y: NEXT x
3210 PAUSE 100
3220 PRINT AT 3,4; "REDR-
     ESOR"
3230 PRINT AT 5,7; "IN"
3240 PRINT AT 7,5; "PUNTE"
3250 SCROLL 8,5
3260 PAUSE 0
3270 FOR x=0 TO 10: FOR
     y=0 TO 15
3280 PRINT AT x,y; "  "
3290 NEXT y: NEXT x
3300 CIRCLE 10,140,2: PLOT
     10,142
3310 DRAW 0,18: DRAW 15,0:
     DRAW 0,-5
3320 FOR i=1 TO 10
3330 DRAW 0,-5,-PI: NEXT
     i
3340 DRAW 0,-5: DRAW
     -15,0
3350 DRAW 0,18: CIRCLE 10,
     120,2
3360>PLOT 35,160: DRAW 0,
     -60
3370 PLOT 100,170
3380 DRAW -55,0: DRAW 0,
     -5
3390 FOR i=1 TO 14
3400 DRAW 0,-5,PI: NEXT i
3410 DRAW 0, -5: DRAW
     55,0
3420 PAUSE 100: PLOT 25,
     170; "Tr"
3430 PAUSE 100: PLOT 20,155
3440 DRAW 0,-50: PROC sud
3450 PAUSE 50: PLOT 0,134;
     "u1"
3460 PAUSE 100: PLOT 50,160
3470 DRAW 0,-60: PROC sud
3480 PAUSE 50: PLOT 52,150;
     "u2"
3490 PAUSE 0
3500 PLOT 100,170: DRAW
     -15,-15
3510 CIRCLE 100,170,2
3520 PLOT 80,160: DRAW 10,
     -10
3530 DRAW -10,0: DRAW
     0,10
3540 PLOT 75,155: DRAW 10,
     -10
3550 PLOT 65,165; "D1"
3560 PLOT 80,150: DRAW
     -20,-20
3570 CIRCLE 60,130,2
3580>PAUSE 100: PLOT 60,130
3590 DRAW 18,0: CIRCLE 80,
     130,2
3600 PLOT 82,130: DRAW 8,0
3610 DRAW 0,2: DRAW 20,0
3620 DRAW 0,-4; DRAW
     -20,0: DRAW 0,2
3630 PLOT 110,130: DRAW
     8,0
3640 CIRCLE 120,130,2
3650 PLOT 122,130: DRAW
     18,0
3660 CIRCLE 140,130,2
3670 PLOT 92,125; "Rs": PA-
     USE 100
3680 PLOT 140,130: DRAW
     -20,-20
3690 PLOT 115,115: DRAW 10,
     -10
3700 DRAW -10,0: DRAW
     0,10
3710 PLOT 110,110: DRAW 10,
     -10
3720 PLOT 115,105: DRAW
     -15,-15
3730 CIRCLE 100,90,2
3740 PAUSE 50: PLOT 125,110;
     "D2"
3750 PAUSE 200: PLOT 90,140
3760 DRAW 20,0: PROC est
```

```
3770 PAUSE 50: PLOT 96,150;
     "u"
3780 >PLOT 76,127; "+":
     PLOT 116,127; "–"
3790 PAUSE 800
3800 PLOT 100,90: DRAW
     –15,15
3810 PLOT 80,100: DRAW
     10,10
3820 DRAW –10,0: DRAW
     0,–10
3830 PLOT 75,105: DRAW 10,
     10
3840 PLOT 80,110: DRAW
     –20,20
3850 PAUSE 50: PLOT 60,105;
     "D3"
3860 PAUSE 100
3870 PLOT 140,130: DRAW
     –20,20
3880 PLOT 115,145: DRAW
     10,10
3890 DRAW –10,0: DRAW 0,
     –10
3900 PLOT 110,150: DRAW 10,
     10
3910 PLOT 115,155: DRAW
     –15,15
3920 PAUSE 50: PLOT 125,
     165; "D4"
3930 PAUSE 0: STOP
3940 SAVE "Bi" LINE 10
```

4.3. PUNTEA REDRESOARE („PUNTE")

Acest program reprezintă o altă modalitate de abordare a unui anumit tip de redresor bialternanță, cel în punte, cu diode semiconductoare. Șiruri de pixeli se deplasează în sensul curentului, atît pe căi permise, cît și pe drumuri interzise. Dacă pixelii întîlnesc o diodă așezată invers, sau regiuni de potențial mai mare, se întorc, căutînd calea permisă.

Public acest program ca apreciere a activității elevei Dana Ceuca în cadrul cercului de informatică.

```
10 >BORDER 4: PAPER 7:
INK 0: CLS
20 CIRCLE 15,160,3: DRAW
22,0: DRAW 0,–30
30 FOR i=1 TO 10: PLOT
35+i,130: DRAW 0,–80:
NEXT i
40 PLOT 40,50: DRAW 0,
–20: DRAW –22,0: CIRCLE
15,30,3
50 PRINT AT 4,8; "PRIMA-
RUL": PRINT AT 5,10;
"TRANSFORMATORULUI":
FOR i=0 TO 10: BEEP .125,
10+i: NEXT i: PAUSE 75:
FOR j=4 TO 5: FOR i=8 TO
31: PRINT AT j,i; " ":
NEXT i: NEXT j: PAUSE 50
60 FOR i=0 TO 1: PLOT
50+5*i,115: DRAW 0,–50:
NEXT i
70 PLOT 110,160: DRAW
–45,0: DRAW 0,–30: FOR
i=0 TO 10: PLOT 60+i, 130:
```

```
DRAW 0,-80: NEXT i: PLOT
65,50: DRAW 0,-20: DRAW
35,0
80 PRINT AT 14,11: "SE-
CUNDARUL"; AT 15,13;
"TRANSFORMATORULUI";
FOR i=0 TO 10: BEEP .125,
10+i: NEXT i: PAUSE 75:
FOR j=14 TO 15: FOR i=11
TO 31: PRINT AT j,i; "  ":
NEXT i: NEXT j
90 PAUSE 50
100 PRINT AT 3,9; "Daca
la bornele prima-": PRINT AT
4,9; "rului se aplica o ten-":
PRINT AT 5,11; "siune alter-
nativa u1": PRINT AT 6,11;
". . . .": FOR i=0 TO 8:
BEEP .125,20-i: NEXT i:
PAUSE 100
110 PLOT 25,150: DRAW
0,-100: DRAW OVER 1;5,0:
DRAW OVER 1;-5,-10:
DRAW OVER 1; -5,10: DRAW
OVER 1;5,0: PRINT FLASH
1; AT 9,0; "u1"
120 FOR i=0 TO 5: BEEP
.1,14: BEEP .1,21: NEXT i:
PRINT AT 9,0; FLASH 0:
"u1"
130 PAUSE 25
140 PRINT AT 8,16; ". . .
atunci la": PRINT AT 9,16;
"secundar va": PRINT AT
10,14; "aparea o tensiune":
PRINT AT 11,15; "alternativa
u2": FOR i=0 TO 20: BEEP .
125,24-i: NEXT i: PAUSE 100
150 PLOT 80,130: DRAW
OVER 1;0,-70: DRAW OVER
1;5,0: DRAW OVER 1; -5,
-10: DRAW OVER 1; -5,10:
DRAW OVER 1;5,0: PRINT
FLASH 1; AT 9,11; "u2"
160 FOR i=0 TO 5: BEEP .
1,14: BEEP .1,21: NEXT i:
PRINT FLASH 0; AT 9,11;
"u2": PAUSE 25
170 FOR j=3 TO 6: FOR
i=9 TO 31: PRINT AT j,i;
"  ": NEXT i: NEXT j
180 FOR i=11 TO 31:
PRINT AT 5,i; "  ": NEXT i:
190 FOR j=8 TO 9: FOR
i=16 TO 31: PRINT AT j,i;
"  ": NEXT i: NEXT j
200 FOR j=10 TO 11: FOR
i=14 TO 31: PRINT AT j,i;
"  ": NEXT i: NEXT j
210 PLOT 100,160: DRAW
70,0
220 PLOT 110,100: DRAW
20,20: PLOT 125,125: DRAW
5,-5: DRAW 20,5: DRAW -15,
15: DRAW -5,-20: DRAW
5,-5: PLOT 143,133: DRAW
27,27
230 PLOT 110,100: DRAW
0,-85: DRAW 30,0: DRAW
0,5: DRAW 60,0: DRAW 0,
-10: DRAW -60,0: DRAW
0,5: PLOT 200,15: DRAW 30,0:
DRAW 0,85
240 PLOT 230,100: DRAW
-27,-27: PLOT 185,65: DRAW
5,-5: DRAW 20,5: DRAW
-15,15: DRAW -5,-20: DR
AW 5,-5: PLOT 190,60: DRAW
-20,-20
250 PLOT 170,40: DRAW
0,-10: DRAW -55,0: DRAW
-10,0,2: DRAW -40,0
260 PLOT 170,160
270 DRAW 20,-20: PLOT
195,145: DRAW -5,-5: DRAW
20,-5: DRAW -15,-15: DRAW
```

```
−5,20: DRAW −5,−5: PLOT
203,127: DRAW 27,−27
 280 PAUSE 50
 290 PLOT 110,100: DRAW
20,−20: PLOT 135,85: DRAW
−5,−5: DRAW 20,−5: DRAW
−15,−15: DRAW −5,20:
 DRAW −5,−5: PLOT
143,67: DRAW 27,−27
 300 PAUSE 50
 310 PLOT 110,100: DRAW
0,−40: PLOT 230,100: DRAW
0,−40
 320 PRINT FLASH 1; AT
4,15; "D1"; AT 4,26; "D2"; AT
14,15; "D3";AT 14,26; "D4";
PAUSE 75: PRINT AT 21,
0; "D1,D2,D3,D4-diode": FOR
i=0 TO 8: BEEP .2,24: BEEP
.2,17: NEXT i
 330 PRINT FLASH 0; AT
4,15; "D1"; AT 4,26; "D2";
AT 14,15; "D3";AT 14,26;
"D4": GO SUB 1920
 340 PRINT FLASH 1; AT
17,24; "Rs": PAUSE 50:
PRINT AT 21,0:" Rs-rezistorul
de sarcina": FOR i=0 TO 8:
BEEP 2,22: BEEP.2,14: NEXT
i: PRINT FLASH 0; AT
17,24; "Rs": GO SUB 1920
 350 PAUSE 50
 360 PAUSE 100: PRINT AT
21,0; "FUNCTIONAREA RE-
DRESORULUI": FOR j=1 TO
3: FOR i=0 TO 10: BEEP .1
25,13+i NEXT i: PAUSE 10:
NEXT j: GO SUB 1920
370 PRINT AT 21,0; "IN PRIMA
SEMIPERIOADA": FOR i=0
TO 5: BEEP .3,17: PAUSE 10:
NEXT i: GO SUB 1920
 380 PAUSE 0
 390 FOR i=0 TO 9: BEEP
.1,13+8*RND: PLOT OVER
1;69,130+3*i: NEXT i
 400 FOR i=0 TO 15: PLOT
OVER 1; 69+6*i,157: BEEP
.1,18+8*RND: NEXT i
 410 FOR i=0 TO 6: PLOT
OVER 1;170+3*i,157−3*i:
BEEP .1,18+8*RND: NEXT i
 420 CIRCLE OVER 1;197,
132,20: PRINT FLASH 1; AT
21,0; "D2 este blocata": FOR
I=0 TO 5: BEEP .1,14: BEEP
.1,21: NEXT I: GO SUB 1920
 430 CIRCLE OVER 1; 197,
132,20: FOR i=0 TO 6: PLOT
INVERSE 1; 170+3*6−3*i,
157−3*6+3*i: PAUSE 10:
NEXT i: PAUSE 20
 440 FOR i=0 TO 19: PLOT
OVER 1; 171−3*i,157−3*i:
BEEP .1,18+8*RND: NEXT i
 450 FOR i=0 TO 6: PLOT
OVER 1;113+3*i, 100−3*i:
BEEP 0.1,18+8*RND: NEXT i
 460 CIRCLE OVER 1; 137,73,
20: PRINT AT 21,0; FLASH
1; "D3 este blocata": FOR
I=0 TO 5: BEEP .1,14: BEEP
.1,21: NEXT I: GO SUB 1920
 470 CIRCLE OVER 1; 137,
73,20: FOR i=0 TO 6: PLOT
INVERSE 1; 113+18−3*i,
100−18+3*i: PAUSE 10:
NEXT i
 480 FOR i=0 TO 26: PLOT
OVER 1; 113,100−3*i: BEEP
0.1,18+9*RND: PAUSE 2:
NEXT i
 490 FOR i=0 TO 14: PLOT
OVER 1; 114+6*i,18: BEEP
0.1,18+8*RND: NEXT i
 500 PLOT 145,25: DRAW
50,0: DRAW 0,3: DRAW 5,
```

```
−3: DRAW −5, −3: DRAW 0,3: PRINT FLASH 1; AT 17,22; "u": PAUSE 50: PRINT AT 21,0; "u-tensiunea redresata": FOR i=0 TO 10: BEEP .12,24: BEEP .12,17: NEXT i: GO SUB 1920: PRINT FLASH 0; AT 17,22; "u"
 510 FOR i=0 TO 4: PLOT 201+6*i, 18: BEEP .1,18+8*RND: NEXT i
 520 FOR i=0 TO 26: PLOT OVER 1; 226,18+3*i: BEEP 0.1,18+8*RND: NEXT i
 530 FOR i=0 TO 19: PLOT OVER 1; 228−3*i, 97+3*i: BEEP 0.1,18+8*RND: NEXT i
 540 CIRCLE OVER 1; 169, 158,10: PRINT FLASH 1; AT 21,0; "CALE DE POTENTIAL MAI MARE": FOR i=0 TO 8: BEEP .12,24: BEEP .12,15: NEXT i: CIRCLE OVER 1; 169,158,10: GO SUB 1920
 550 FOR i=0 TO 19: PLOT OVER 1;228−3*19+3*i, 97+3*19−3*i: PAUSE 10: NEXT i
 560 FOR i=0 TO 19: PLOT OVER 1; 226−3*i, 100−3*i: BEEP .1,18+8*RND: NEXT i
 570 FOR i=0 TO 19: PLOT 170−3*i,43+3*i: BEEP 0.1,18+8*RND: NEXT i
 580 CIRCLE OVER 1;110, 100,10: PRINT FLASH 1; AT 21,0; "CALE DE POTENTIAL MAI MARE": FOR i=0 TO 15: BEEP .11,25: NEXT i: GO SUB 1920: CIRCLE OVER 1;110,100,10
 590 FOR i=0 TO 19: PLOT OVER 1; 170−3*19+3*i, 43+3*19−3*i: PAUSE 10: NEXT i
 600 FOR i=0 TO 3: PLOT OVER 1; 173,43−3*i: BEEP .1,18+8*RND: NEXT i
 610 FOR i=0 TO 16: PLOT OVER 1; 173−6*i,33: BEEP .1,18+8*RND: NEXT i
 620 FOR i=0 TO 5: PLOT OVER 1;68,33+3*i: BEEP 0.1,18+8*RND: NEXT i
 630 PAUSE 0
 640 FOR i=0 TO 9: PLOT OVER 1; 69,130+3*i: NEXT i
 650 FOR i=0 TO 15: PLOT OVER 1; 69+6*i,157: NEXT i
 660 FOR i=0 TO 19: PLOT OVER 1; 171−3*i,157−3*i: NEXT i
 670 FOR i=1 TO 26: PLOT OVER 1; 113,100−3*i: NEXT i
 680 FOR i=0 TO 14: PLOT OVER 1;114+6*i,18: NEXT i
 690 FOR i=0 TO 4: PLOT OVER 1;201+6*i,18: NEXT i
 700 FOR i=0 TO 26: PLOT OVER 1; 226,18+3*i: NEXT i
 710 FOR i=0 TO 19: PLOT OVER 1; 226−3*i, 100−3*i: NEXT i
 720 FOR i=0 TO 3: PLOT OVER 1;173,43−3*i: NEXT i
 730 FOR i=0 TO 16: PLOT OVER 1; 173−6*i,33: NEXT i
 740 FOR i=0 TO 5: PLOT OVER 1;68,33+3*i: NEXT i
 750 PAUSE 200
 760 PRINT AT 21,0; "IN A DOUA SEMIPERIOADA": FOR i=0 TO 5: BEEP.4,21: NEXT i: PAUSE 25: GO SUB 1920: PAUSE 50
 770 PLOT 25,150: DRAW
```

```
OVER 1 ;0-100 : DRAW OVER 1 ;5,0 : DRAW OVER 1 ;-5, -10 : DRAW OVER 1 ;-5,10 : DRAW OVER 1 ;5,0
780 PLOT 25,40 : DRAW 0,100 : DRAW OVER 1 ;5,0 : DRAW OVER 1 ;-5,10 :
DRAW OVER 1 ;-5,-10 : DRAW OVER 1 ;5,0 : PRINT FLASH 1 ;AT 9,0 ; "u1"
790 FOR i=0 TO 5 : BEEP .1,14 : BEEP .1,21 : NEXT i : PRINT AT 9,0 ; FLASH 0 ; "u1"
800 PLOT 80,120 : DRAW OVER 1 ; 0,-60 : DRAW OVER 1 ;5,0 : DRAW OVER 1 ;-5, -10 : DRAW OVER 1 ;-5,10 : DRAW OVER 1 ;5,0
810 PLOT 80,50 : DRAW OVER 1 ;0,70 : DRAW OVER 1 ; 5,0 : DRAW OVER 1 ;-5,10 : DRAW OVER 1 ; -5, -10 : DRAW OVER 1 ;5,0 : PRINT FLASH 1 ; AT 9,11 ; "u2"
820 FOR i=0 TO 5 : BEEP .1,14 : BEEP .1,21 : NEXT i : PRINT FLASH 0 ; AT 9,11 ; "u2" : PAUSE 25
830 FOR i=2 TO 7 : PLOT OVER 1 ; 68,54-3 *i : BEEP 0.1,18+8. *RND : NEXT i
840 FOR i=0 TO 16 : PLOT OVER 1 ; 173-6 *16+6 *i,33 : BEEP 0.1,18+8 *RND : NEXT i
850 FOR i=0 TO 3 : PLOT OVER 1 ; 173,34+3 *i : BEEP .1,18+8 *RND : NEXT i
860 FOR i=0 TO 7 : PLOT OVER 1 ;173+3 *i,45+3 *i : BEEP .1,18+8 *RND : NEXT i
870 CIRCLE OVER 1 ; 197, 72,20 : PRINT FLASH 1 ; AT 21,0 ; "D4 este blocata" : FOR i=0 TO 8 : BEEP 0.11,22 : BEEP 0.11,16 : NEXT i : CIRCLE OVER 1 ;197,72,20 : GO SUB 1920
880 FOR i=0 TO 7 : PLOT OVER 1 ;173+21-3 *i, 45+ +21-3 *i : NEXT i
890 FOR i=0 TO 19 : PLOT OVER 1 ; 173-3 *i, 43+3 *i : BEEP .1,18+8 *RND : NEXT i
900 FOR i=0 TO 7 : PLOT OVER 1 ;173-3 *19+3 *i, 43 +3 *19+3 *i : BEEP .1,18+ 8 *RND : NEXT i
910 CIRCLE OVER 1 ; 136, 133,20 : PRINT FLASH 1 ; AT 21,0 ; "D1 este blocata" : FOR i=0 TO 9 : BEEP .12,24 : BEEP .12,17 : NEXT i : CIRCLE OVER 1 ;136,133,20 : GO SUB 1920
920 FOR i=0 TO 7 : PLOT OVER 1 ;173-3 *19+21-3 *i, 43+3 *26-3 *i : NEXT i
930 FOR i=0 TO 26 : PLOT OVER 1 ; 113, 100-3 *i : BEEP 0.1,18+9 *RND : NEXT i
940 FOR i=0 TO 14 : PLOT OVER 1 ; 114+6 *i,18 : BEEP 0.1,18+8 *RND : NEXT i
950 FOR i=0 TO 4 : PLOT OVER 1 ;201+6 *i, 18 : BEEP .1,18+8 *RND : NEXT i
960 PLOT 145,25 : DRAW 50,0 : DRAW 0,3 : DRAW 5, -3 : DRAW -5,-3 : DRAW 0,3 : PRINT FLASH 1 ; AT 17,22; "u" : PAUSE 50 : PRINT AT 21,0 ; "u-tensiunea redresata" : FOR i=0 TO 10 : BEEP .12, 24 : BEEP .12,17 : NEXT i : GO SUB 1920 : PRINT FLASH 0 ; AT 17,22 ; "u"
970 FOR i=0 TO 26 : PLOT OVER 1 ; 226, 18+3 *i : BEEP 0.1,18+8 *RND : NEXT i
```

```
980 FOR i=0 TO 19: PLOT
OVER 1; 226-3*i,100-3*i:
BEEP .1,18+8*RND: NEXT i
990 CIRCLE OVER 1;170,
45,10: PRINT FLASH 1; AT
21,0; "CALE DE POTENTIAL
MAI MARE": FOR i=0 TO 8:
BEEP .12,24: BEEP .12,16:
NEXT i: CIRCLE OVER 1;
170,45,10: GO SUB 1920
1000 FOR i=0 TO 19: PLOT
OVER 1; 226-3*19+3*i,
100-3*19+3*i: NEXT i
1010 FOR i=0 TO 19: PLOT
OVER 1; 228-3*i,97+3*i:
BEEP 0.1,18+8*RND: NEXT
i
1020 FOR i=0 TO 19: PLOT
OVER 1; 171-3*i: BEEP
.1,18+8*RND: NEXT i
1030 CIRCLE OVER 1; 169-
3*19,157-3*19,10: PRINT
FLASH 1; AT 21,0; "CALE DE
POTENŢIAL MAI MARE":
FOR i=0 TO 8: BEEP .12,24:
BEEP .12,15: NEXT i: CIRCLE
OVER 1;169-3*19,157-3*19,
10: GO SUB 1920
1040 FOR i=0 TO 19: PLOT
OVER 1; 171-3*19+3*i, 157
-3*19+3*i: BEEP .1,18
+8*RND: NEXT i
1050 FOR i=0 TO 15: PLOT
OVER 1; 69+6*15-6*i, 157:
BEEP .1,18+8*RND: NEXT i
1060 FOR i=0 TO 9: BEEP
.1,13+8*RND: PLOT OVER
1;69,130+27-3*i: NEXT i:
PAUSE 0
1070 FOR i=2 TO 7: PLOT
OVER 1;68,54-3*i: NEXT i
1080 FOR i=0 TO 16: PLOT
OVER 1; 173-6*16+6*i, 33:
NEXT i
1090 FOR i=0 TO 3: PLOT
OVER 1;173,34+3*i: NEXT i
1100 FOR i=0 TO 19: PLOT
OVER 1; 173-3*i,43+3*i:
NEXT i
1110 FOR i=0 TO 26: PLOT
OVER 1; 113,100-3*i: NEXT i
1120 FOR i=0 TO 4: PLOT
OVER 1;201+6*i,18: NEXT i
1130 FOR i=0 TO 14: PLOT
OVER 1; 114+6*i,18: NEXT i
1140 FOR i=0 TO 26: PLOT
OVER 1; 226,18+3*i: NEXT i
1150 FOR i=0 TO 19: PLOT
OVER 1; 228-3*i,97+3*i:
NEXT i
1160 FOR i=0 TO 15: PLOT
OVER 1; 69+6*15-6*i,157:
NEXT i
1170 FOR i=0 TO 9: PLOT
OVER 1;69,130+27-3*i:
NEXT i
1180 PAUSE 0: CLS: PRINT
AT 10,0; "DACA DORITI/
(NU DORITI) RELUAREA
PROGRAMULUI TASTATI
d/(n)"
1190 INPUT a$
1200 IF ?a$="d" THEN CLS:
GO TO 10
1210 IF a$="n" THEN PAUSE
5: CLS
1220 PRINT AT 7,1; "VARIA-
TIA IN TIMP A TENSIUNILOR
:": PRINT AT 9,4; "u1: la
bornele primarului" ;AT 10,4;
"—u2: la bornele secundarului";
AT 11,4; "—u: tensiunea redre-
sata"; AT 13,2; "(PENTRU
PATRU PERIOADE)"
1230 FOR i=0 TO 2: FOR
j=1 TO 2: BEEP .1,16+2*i:
BEEP .1,18+2*i: BEEP .2,18
+2*i: NEXT j: BEEP .1,16+
```

```
2*i: BEEP .1,18+2*i: BEEP
.1,18+2*i: BEEP .1,21+2*i:
BEEP .1,20+2*i: BEEP .1,16
+2*i: BEEP .2,18+2*i:
PAUSE 1: NEXT i
1240 PAUSE 50: CLS
1250 PLOT 15,30: GO SUB 1930
1260 PLOT 20,0: GO SUB 1940
1270 PLOT 15,90: GO SUB 1930
1280 PLOT 20,60: GO SUB
1940
1290 PLOT 15,145: GO SUB
1930
1300 PLOT 20,120: GO SUB
1940
1310 PRINT AT 15,1; "u"; AT
0,0; "u1"; AT 7,0; "u2"
1320 PRINT AT 19,25; "t"; AT
11,25; "t"; AT 4,25; "t"
1330 FOR i=0 TO 159
1340 LET y=30+ABS (18*
*SIN (PI/20*i))
1350 LET y1=30+ABS (18*
SIN (PI/20*(i+1)))
1360 PLOT 20+i,y: DRAW 1,
y1-y
1370 LET y=90+20*SIN (PI/
20*i)
1380 LET y1=90+20*SIN (PI/
20*(i+1))
1390 PLOT 20+i,y: DRAW
1,y1-y
1400 LET y=145-22*SIN
(PI/20*i)
1410 LET y1=145-22*SIN
(PI/20*(i+1))
1420 PLOT 20+i,y: DRAW 1,
y1-y: NEXT i
1430 PAUSE 300: CLS: PRINT
AT 9,0; "DACA DORITI/? (NU
DORITI) SA REVEDETI GRA-
FICELE TASTATI d/(n)"
1440 INPUT "b$="; b$: IF
b$="d"THEN GO TO 1220:
IF b$="n" THEN GO TO
1450
1450 PAUSE 50: CLS
1460 LET i=USR "T"
1470 POKE i+0,BIN 00000010
1480 POKE i+1,BIN 00100101
1490 POKE i+2,BIN 00010101
1500 POKE i+3,BIN 00001000
1510 POKE i+4,BIN 00010100
1520 POKE i+5,BIN 00100100
1530 POKE i+6,BIN 00100100
1540 POKE i+7,BIN 00011000
1550 LET i=USR "P"
1560.POKE i=0,BIN 0000000
1570 POKE i+1,BIN 00000001
1580 POKE i+2,BIN 0111110
1590 POKE i+3,BIN 10100100
1600 POKE i+4,BIN 00100100
1610 POKE i+5,BIN 00100100
1620 POKE i+6,BIN 00100100
1630 POKE i+7,BIN 00000000
1640 LET i=USR "O"
1650 POKE i+0,BIN 00000000
1660 POKE i+1,BIN 00000000
1670 POKE i+2,BIN 00000000
1680 POKE i+3,BIN 00100100
1690 POKE i+4,BIN 01000010
1700 POKE i+5,BIN 01011010
1710 POKE i+6,BIN 00100100
1720 POKE i+7,BIN 00000000
1730 PRINT AT 5,7; "EXPRE-
SIA MATEMATICA"; AT 6,3;
"A TENSIUNII REDRESATE
ESTE:"
1740 FOR i=0 TO 10: BEEP
.1,12+i: NEXT i
1750 PAUSE 25
1760 PRINT AT 12,3; "u=
2Um/P-(4Um/3P)COS 20t-
..."
1770 FOR i=0 TO 10: BEEP
.1,22-i: NEXT i: PAUSE 25
1780 PRINT AT 17,4; "unde:";
AT 18,9; "Um-amplitudinea";
```

```
AT 19,12;" tensiunii redresate"
1790 FOR i=0 TO 10: BEEP
.1,12+i: NEXT i
1800 PAUSE 25
1810 PRINT AT 20,10; "0-pulsatia"
1820 FOR i=0 TO 10: BEEP
.1,22-i: NEXT i: PAUSE 150:
CLS
1830 PRINT AT 2,3; "u=2Um/
P-(4Um/3P) COS 20t-..."
1840 FOR i=0 TO 10: BEEP
.1,22-i: NEXT i: PAUSE 25
1850 PRINT AT 5,0; "(U=)
=2Um/P-componenta continua"; AT 6,11; "a tensiunii redresate"
1860 FOR i=0 TO 10: BEEP
.1,12+i: NEXT i: PAUSE 25
1870 PRINT AT 9,0; "(Um')=
4Um/3P-amplitudinea primei";
AT 10,10; "componente alternative"
1880 FOR i=0 TO 10: BEEP
.1,22-i: NEXT i: PAUSE 25
1890 PRINT AT 13,4; "T=
factor de ondulatie"; AT 15,9;
"T=(Um')/(U=)"; AT 16,5; "T=
=(4Um/3P)/(2Um/P)"; AT 17,
10; "T=0,(6)"
1900 FOR i=0 TO 6: BEEP
.1,12+i:NEXT i
1910 PAUSE 0: STOP
1920 FOR i=0 TO 31: PRINT
AT 21,i; " ": NEXT i: RETURN
1930 DRAW 187,0: DRAW 0,3:
DRAW 5,-3: DRAW -5,-3:
DRAW 0,3: RETURN
1940 DRAW 0,50: DRAW 3,0:
DRAW -3,5: DRAW -3,-5:
DRAW 3,0: RETURN
1950 SAVE "Punte" LINE 10
```

4.4. ETAJ DE AMPLIFICARE CU TRANZISTOR ÎN CONEXIUNEA EC („ETAJ")

După prezentarea schemei electrice a unui etaj amplificator cu tranzistor în conexiunea cu emitor comun, se reprezintă grafic la intrarea și la ieșirea acestuia, dependența tensiunilor de timp. Elevii folosind imaginea de pe ecran vor răspunde la două întrebări:

1. În ce relație de fază sînt cele două tensiuni?
2. Care este amplificarea realizată cu acest etaj?

Deoarece graficele celor două tensiuni se execută simultan, răspunsul la prima întrebare este ușor de dat. Pentru a da răspunsul la a doua întrebare este necesară o riglă cu ajutorul căreia se măsoară amplitudinea celor două tensiuni. Se consideră că factorul de scară este același pentru ambele grafice.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
```

```
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1; AT
   3,5; "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="ETAJ"
130 FOR i=1 TO 4
140 BEEP .1,RND *30
150 PLOT 75+i *20,120; a$(i)
160 NEXT i
170 LET b$="AMPLIFICA-
   TOR"
180 FOR i=1 TO 12
190 BEEP .1,RND *30
200 PLOT 60+i *10,100; b$(i)
210 NEXT i
220 >PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND *30
250 PLOT 40+i *10,80 ;z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND *30
300 PLOT 40,156—i *16;" *"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND *30
340 PLOT 40+i *10,60; " *"
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND *30
380 PLOT 210,60+i *16; " *"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210—i *10,140;
   " *"
430 NEXT i
440 >DATA 127,39,56,55,32,76,
   72,67,67,32,67,46,71,79,73,
   65
450 PAUSE 50: PLOT 38,142
460 DRAW 0,—100: DRAW
   182,0
470 DRAW 0,100: DRAW
   —182,0
480 PAUSE 100
490 BEEP .4,19: BEEP .2,23
500 BEEP .4,28: BEEP .2,26
510 BEEP .4,24: BEEP .2,23
520.BEEP .4,21: BEEP .2,23
530 BEEP .4,24: BEEP .2,26
540 BEEP .4,23: BEEP .2,21
550 BEEP .2,21: BEEP .2,19
560 BEEP .2,23: BEEP .4,26
570 BEEP .2,26
580 IF CODE z$(13)< >71
   THEN NEW
590 CSIZE 0: PAUSE 100
600 FOR i=1 TO 150
610 SCROLL 7: NEXT i
620 CIRCLE 10,100,2
630 PLOT 12,100: DRAW 63,0
640 >PLOT 75,105: DRAW 0,
   —10
650 PLOT 80,105: DRAW 0,
   —10
660 PLOT 80,100: DRAW 25,0
670 CIRCLE 90,100,2
680 CIRCLE 110,100,15
690 PLOT 105,110: DRAW 0,
   —20
700 PLOT 105,105: DRAW
   25,25
710DRAW 0,10: DRAW —2,0
720 DRAW 0,20: DRAW 4,0
730 DRAW 0,—20: DRAW
   —2,0
740 CIRCLE 130,130,2
750 PLOT 130,160: DRAW
   0,10
760 DRAW —40,0: DRAW
   0,—20
770 DRAW 2,0: DRAW 0,—20
780 DRAW —4,0: DRAW
   0,20
```

```
790 DRAW 2,0
800 PLOT 90,130: DRAW 0,-50
810 CIRCLE 10,35,2: PLOT 12,35
820 DRAW 166,0: CIRCLE 180,35,2
830 CIRCLE 90,35,2: PLOT 90,35
840 DRAW 0,25: DRAW -2,0
850 DRAW 0,20: DRAW 4,0
860>DRAW 0,-20: DRAW -2,0
870 PLOT 130,30: DRAW 0,40
880 DRAW -25,25: DRAW 2,-5
890 DRAW 4,4: DRAW -5,2
900 PLOT 120,30: DRAW 20,0
910 CIRCLE 130,35,2
920 FOR x=115 TO 135 STEP 5
930 PLOT x,25: DRAW 5,5
940 NEXT x
950 PLOT 130,130: DRAW 10,0
960 PLOT 140,135: DRAW 0,-10
970 PLOT 145,135: DRAW 0,-10
980 PLOT 145,130: DRAW 33,0
990 CIRCLE 180,130,2
1000 PLOT 130,170: DRAW 30,0
1010 DRAW 0,-35: DRAW 0,-10,-PI
1020 DRAW 0,-15
1030 PLOT 155,110: DRAW 10,0
1040 PLOT 150,105: DRAW 20,0
1050 PLOT 155,100: DRAW 10,0
1060 PLOT 150,95: DRAW 20,0
1070 PLOT 155,90: DRAW 10,0
1080>PLOT 150,85: DRAW 20,0
1090 PLOT 160,85: DRAW 0,-50
1100 CIRCLE 160,35,2
1110 PAUSE 0
1120 PLOT 70,118; "C1"
1130 PLOT 137,145; C2"
1140 PAUSE 200
1150 PLOT 70,144; "R1"
1160 PLOT 96,74; "R2"
1170 PLOT 110,154; "Rs"
1180 PAUSE 100
1190 PLOT 140,100; "E"
1200 PAUSE 100
1210 PLOT 150,80; "+"
1220 PLOT 150,120; "-"
1230 PLOT 95,60; "+"
1240 PLOT 95,85; "-"
1250 PLOT 95,130; "+"
1260 PLOT 95,160; "-"
1270 PAUSE 0
1280 DEF PROC est
1290 DRAW -5,2: DRAW 0,-4
1300>DRAW 5,2
1310 END PROC
1320 DEF PROC sud
1330 DRAW 2,5: DRAW -4,0
1340 DRAW 2,-5
1350 END PROC
1360 BEEP .5,30
1370 PLOT 10,95: DRAW 0,-55
1380 PROC sud
1390 PAUSE 100
1400 DEF PROC sun
1410 FOR i=1 TO 3
1420 BEEP .2,30: BEEP .2,35: BEEP .2,40
```

```
1430 NEXT i
1440 END PROC
1450 PLOT FLASH 1 ;0,30 ; "u"
1460 PLOT FLASH 1 ;8,26 ;
     "int"
1470 PROC sun
1480 PLOT FLASH 0 ;0,30 ; "u"
1490 PLOT FLASH 0 ;8,26 ;
     "int"
1500 PAUSE 100 : BEEP .5,30
1510 >PLOT 5,70
1520 DRAW 80,0 : PROC est
1530 PAUSE 100
1540 PLOT FLASH 1 ;75,65 ; "t"
1550 PROC sun
1560 PLOT FLASH 0 ;75,65 ; "t"
1570 PAUSE 100 : BEEP .5,30
1580 PLOT 180,125
1590 DRAW 0,-85 : PROC sud
1600 PAUSE 100
1610 PLOT FLASH 1 ;170,30 ;
     "u"
1620 PLOT FLASH 1 ;178,26 ;
     "ies"
1630 PROC sun
1640 PLOT FLASH 0 ;170,30 ;
     "u"
1650 PLOT FLASH 0 ;178,26 ;
     "ies"
1660 PAUSE 100 : BEEP .5,30
1670 PLOT 175,80
1680 DRAW 80,0 : PROC est
1690 PAUSE 100
1700 PLOT FLASH 1 ;245,76 ;
     "t"
1710 PROC sun
1720 PLOT FLASH 0 ;245,76 ;
     "t"
1730 >PAUSE 0
1740 PRINT AT 21,0 : "ATEN-
     TIE LA CELE DOUA TEN-
     SIUNI !"
1750 PAUSE 0
1760 FOR x=0 TO 59
1770 LET y=70+10 * SIN
     (PI * x/15)
1780 LET y1=70+10 * SIN
     (PI * (x+1)/15)
1790 PLOT 10+x,y : DRAW
     1,y1-y
1800 LET y=80-40 * SIN (PI
     x/15)
1810 LET y1=80-40 * SIN
     (PI * (x+1)/15)
1820 PLOT 180+x,y : DRAW
     1,y1-y
1830 NEXT x
1840 PAUSE 0
1850 PRINT AT 20,5 ; "IN CE
     RELATIE DE FAZA"
1860 PRINT AT 21,1 ; "SINT
     CELE DOUA TENSI-
     UNI ?"
1870 PAUSE 0
1880 PRINT AT 20,2 ; "DE-
     TERMINATI AMPLIFI-
     CAREA A !"
1890 >PRINT AT 21,0 ; "  "
1900  PAUSE 0
1910 PRINT AT 20,2 ; "PEN-
     TRU TERMOSTABILI-
     ZARE"
1920 PRINT AT 21,2 ; "SE IN-
     TRODUCE GRUPUL
     ReCe."
1930 PAUSE 0
1940 PLOT 128,60 : DRAW 4,0
1950 DRAW 0,-20 : DRAW
     -4,0 : DRAW 0,20
1960 PLOT 110,54 ; "Re"
1970 PAUSE 100
1980 CIRCLE 130,70,2
1990 PLOT 130,70
2000 DRAW 15,0 : DRAW 0,
     -15
2010 PLOT 140,55 : DRAW
     10,0
2020 PLOT 140,50 : DRAW 10,0
```

```
2030 PLOT 145,50: DRAW 0,
     -15
2040 CIRCLE 145,35,2
2050 PLOT 144,65; "Ce"
2060 PLOT 115,44; "+"
2070>PLOT 115,64; "-"
2080 PAUSE 0: STOP
2090 SAVE "Etaj" LINE 10
```

4.5. MODULAȚIA ÎN AMPLITUDINE („MODULAȚIA")

Se reprezintă simultan graficul oscilației modulatoare, purtătoare, și oscilației modulate în amplitudine. Elevii vor răspunde la următoarele întrebări:

— Cum se numesc aceste oscilații?

— Ce frecvență are oscilația modulată?

— Cum variază amplitudinea oscilației modulate?

În continuare sînt date expresiile matematice ale celor trei oscilații și se definește gradul de modulație. Pentru două grade de modulație introduse de utilizator se execută graficele.

Oscilația modulată în amplitudine are trei componente care, pentru un grad de modulație dorit, sînt reprezentate grafic.

În final, tot pentru un grad de modulație dorit, se reprezintă spectrul de amplitudine al oscilației modulate, oscilația modulatoare fiind pur sinusoidală.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90. PRINT FLASH 1; AT
   3,5; "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="MODULATIA"
130 FOR i=1 TO 9
140 BEEP .1,RND*30
150 PLOT 75+i*10,120; a$(i)
160 NEXT i
170 LET b$="IN AMPLITU-
    DINE"
180 FOR i=1 TO 14
190 BEEP .1,RND*30
200 PLOT 50+i*10,100;
    b$(i)
210 NEXT i
220>PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND*30
250 PLOT 40+i*10,80;
    z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND*30
300 PLOT 40,156-i*16; "*"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND*30
340 PLOT 40+i*10,60; "*"
```

```
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND *30
380 PLOT 210,60+i *16; " *"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210-i *10,140 ; " *"
430 NEXT i
440 >PLOT 38,142 : DRAW 0,
    -100
450 DRAW 182,0 : DRAW
    0,100 : DRAW -182,0
460 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73
    65
470 IF CODE z$(13)<>71
    THEN NEW
480 PAUSE 100
490 BEEP .4,19 : BEEP .2,23
500 BEEP .4,28 : BEEP .2,26
510 BEEP .4,24 : BEEP .2,23
520 BEEP .4,21 : BEEP .2,23
530 BEEP .4,24 : BEEP .2,26
540 BEEP .4,23 : BEEP .2,21
550 BEEP .2,21 : BEEP .2,19
560 BEEP .2,23 : BEEP .4,26
570 BEEP .2,26
580 CSIZE 0
590 FOR i=1 TO 175
600 SCROLL 7
610 NEXT i
620 CLS
630 >PRINT #10 ; "MODULA-
    TIA IN AMPLITUDINE"
640 PLOT 20,10 : DRAW 0,165
650 GO SUB 2450
660 PLOT 20,140 : GO SUB
    2450
670 PLOT 20,90 : GO SUB
    2450
680 PLOT 10,150 : DRAW
    240,0
690 GO SUB 2470
700 PLOT 10,110 : DRAW
    240,0
710 GO SUB 2470
720 PLOT 10,50 : DRAW
    240,0
730 GO SUB 2470
740 PRINT AT 1,30 ; "t"
750 PRINT AT 6,30 ; "t"
760 PRINT AT 14,30 ; "t"
770 PAUSE 400
780 PRINT AT 0,3 ; "um-Osci-
    latie modulatoare"
790 PAUSE 400
800 PRINT AT 5,3 ; "up-Osci-
    latie purtatoare"
810 PAUSE 400
820 >PRINT AT 11,3 ; "u-Osci-
    latie modulata"
830 PAUSE 400
840 PRINT AT 1,0 ; "Um"
850 PRINT AT 6,0 ; "Uo"
860 FOR x=20 TO 239
870 LET um=150+10 *COSE
    ((x/40 *PI-.5 *PI))
880 LET um1=150+10 *COSE
    (((x+1)/40 *PI-.5 *PI))
890 LET up=110+15 *COSE
    ((x/8 *PI-2.5 *PI))
900 LET up1=110+15 *COSE
    (((x+1)/8 *PI-2.5 *PI))
910 LET u=50+15 * (1+.7 *
    COSE ((x/40 *PI-.5 *
    PI))) *COSE((x/8 *PI-2.5
    *PI))
920 LET u1=50+15 *(1+.7 *
    COSE (((x+1)/40 *PI-. 5
    *PI))) *COSE (((x+1)/ 8
    *PI-2.5 *PI))
930 PLOT x,um : DRAW 1,
    um1-um
940 PLOT x,up : DRAW 1,
    up1-up
950 >PLOT x,u : DRAW 1,
    u1-u
```

```
960 NEXT x
970 PAUSE 0
980 PRINT OVER 1; AT 0,5; "—Oscilatie modulatoare"; AT 5,5; "—Oscilatie purtatoare"; AT 11,4; "—Oscilatie modulata"
990 PRINT AT 20,0; "Cum se numesc aceste oscilatii?"
1000 PAUSE 0
1010 PRINT AT 20,0; "Ce frecventa are oscilatia modulata?"
1020 PAUSE 0
1030 PRINT AT 20,0; "Cum variaza amplitudinea oscilatiei modulate?"
1040 PAUSE 0: CLS
1050 KEYWORDS 0: LET i=USR "p"
1060 POKE i+0,BIN 00000000
1070 POKE i+1,BIN 00000001
1080 POKE i+2,BIN 00111110
1090 >POKE i+3,BIN 01010010
1100 POKE i+4,BIN 00010010
1110 POKE i+5,BIN 00010010
1120 POKE i+6,BIN 00010010
1130 POKE i+7,BIN 00000000
1140 PRINT AT 0,1; "Cele 3 oscilatii au urmatoarele"
1150 PRINT AT 1,0; "expresii matematice:"
1160 PRINT AT 3,0; "um=Um.COS 2. DPOKE .fm.t"
1170 PRINT AT 5,0; "up=Uo.COS 2.DPOKE .fo.t"
1180 PRINT AT 7,0; "u=Uo (1+"
1190 PRINT FLASH 1; AT 7,7; "m"
1200 PRINT AT 7,8; ".COS 2.DPOKE .fm.t)."
1210 PRINT AT 8,18; "COS 2.DPOKE .fo.t"
1220 PRINT AT 10,0; "Unde:"
1230 PRINT FLASH 1; AT 12,0; "m"
1240 >PRINT AT 12,1; "=(Umax—Umin)/(Umax+Umin)"
1250 PRINT AT 14,0; "se numeşte grad de modulatie si"
1260 PRINT AT 16,0; "este cuprins intre 0 şi 1"
1270 INPUT "Doriti exemple? (d/n)"; s$
1280 CLS
1290 IF s$="n" THEN GO TO 1480
1300 IF s$="d" THEN GO TO 1320
1310 IF s$<>"n" OR s$<>"d" THEN GO TO 1270
1320 INPUT "Dati gradul de modulatie dorit! ";m1
1330 PRINT AT 7,26; "m1="; m1
1340 INPUT "Dati un alt grad de modulatie!"; m2
1350 PRINT AT 16,26; "m2="; m2
1360 >IF m1<0 OR m1>1 THEN PRINT AT 0,0; "Nu s-a respectat intervalul [0,1] pentru gradul de modulatie."
1370 IF m2<0 OR m2>1 THEN PRINT AT 0,0; "Nu s-a respectat intervalul [0,1] pentru gradul de modulatie."
1380 IF m1<0 OR m1>1 OR m2<0 OR m2>1 THEN GO TO 1270
1390 FOR x=20 TO 199
1400 LET y=120+15*(1+m1*COSE ((x/40*PI—.5*
```

```
     PI))) *COSE  ((x/8 *PI
     -2.5 *PI))
1410 LET y1=120+15 *(1+
     m1 *COSE(((x+1)/40 *
     *PI-.5 *PI))) *COSE
     (((x+1)/8 *PI-2.5 *PI))
1420 PLOT x,y :  DRAW 1,
     y1-y
1430 LET y2=40+15 *(1+ m2
     *COSE((x/40*PI-.5*PI)))
     *COSE((x/8 *PI-2.5*
     PI))
1440>LET y3=40+15 *(1+m2
     *COSE(((x+1)/40 *PI-.5
     *PI))) *COSE(((x+1)/8 *
     PI-2.5 *PI))
1450 PLOT x,y2 : DRAW 1,y3-
     y2
1460 NEXT x
1470 GO TO 1270
1480 PAUSE 0 : CLS
1490 PRINT TAB 4; "Oscila-
     tia modulata in amplitu-
     dine se poate descompune
     in urmatoarele componen-
     te :"
1500 PRINT AT 4,1 ; "1) Compo-
     nenta purtatoare, de frec-
     venta fo :"
1510 PRINT AT 7,0 ; "up=Uo.
     COS 2. DPOKE .fo.t"
1520 PRINT AT 9,1 ; "2) Com-
     ponenta laterala inferioara,
     de frecventa (fo-fm) :"
1530 PRINT AT 12,0 ; "ui=
     (m.Uo/2). COS 2. DPOKE.
     (fo-fm).t"
1540>PRINT AT 14,1 ; "3) Com-
     ponenta laterala superioa
     -ra, de frecventa (fo+fm) :"
1550 PRINT AT 17,0 ; "us=
     (m.Uo/2). COS 2. DPOKE
     .(fo+fm).t"
1560 PAUSE 0 : CLS
1570 CLS
1580 INPUT "Pentru ce grad
     de modulatie do-riti repre-
     zentarea grafica ?" ; m
1590 IF m<0 OR m>1 THEN
     PRINT AT 5,5 ; "Gradul de
     modulatie dat nu apartine
     intervalului [0,1]"
1600 PRINT AT 0,27 ; "m=" ;
     m
1610 IF m<0 OR m>1 THEN
     GO TO 1560
1620 PLOT 20,110 :   DRAW
     0,65
1630 GO SUB 2450
1640 PLOT 10,140 :   DRAW
     230,0
1650 GO SUB 2470
1660 PLOT 20,60 : DRAW 0,45
1670>GO SUB 2450
1680 PLOT 10,80 : DRAW 230,0
1690 GO SUB 2470
1700 PLOT 20,10 : DRAW 0,45
1710 GO SUB 2450
1720 PLOT 10,30 :   DRAW
     230,0
1730 GO SUB 2470
1740 PRINT AT 0,0 ; "up"
1750 PRINT AT 9,0 ; "ui"
1760 PRINT AT 15,0 ; "us"
1770 PRINT AT 4,31 ; "t"
1780 PRINT AT 12,31 ; "t"
1790 PRINT AT 18,31 ; "t"
1800 FOR x=20 TO 229
1810 LET y=140+30 *COSE
     ((x/8 *PI-2.5 *PI))
1820 LET y1=140+30 *COSE
     (((x+1)/8 *PI-2.5 *PI))
1830 PLOT x,y :   DRAW 1,
     y1-y
1840 LET y2=80+m *15 *
     COSE ((x/10 *PI-2 *PI))
1850>LET y3=80+m *15 *
```

```
     COSE(((x+1)/10*PI-2*
     PI))
1860 PLOT x,y2: DRAW 1,
     y3-y2
1870 LET y4=30+m*15*
     COSE((3*x/20*PI-3*
     PI))
1880 LET y5=30+m*15*
     COSE((3*(x+1)/20*PI-
     3*PI))
1890 PLOT x,y4: DRAW 1,
     y5-y4
1900 NEXT x
1910 IF m=0 THEN PRINT
     AT 21,3; "Nu apar com-
     ponente laterale."
1920 INPUT "Doriti un alt ex-
     emplu? (d/n)"; b$
1930 IF b$="d" THEN GO
     TO 1570
1940 IF b$="n" THEN CLS
1950 IF b$<>"d" AND
     b$<>"n" THEN GO TO
     1920
1960 PAUSE 0
1970 CLS
1980 PRINT TAB 5; "SPEC-
     TRUL DE AMPLITU-
     DINE"
1990 >PRINT AT 2,9; "AL
     OSCILATIEI MA"
2000 INPUT "Introduceti gra-
     dul de modulatie!"; m
2010 PRINT AT 8,27; "m=";
     m
2020 IF m<0 OR m>1 THEN
     PRINT AT 10,0; "Gra-
     dul de modulatie nu apar-
     tine intervalului [0,1]"
2030 IF m<0 OR m>1 THEN
     GO TO 1960
2040 PLOT 20,10: DRAW
     0,135
2050 GO SUB 2450
2060 PLOT 10,20: DRAW
     240,0
2070 GO SUB 2470
2080 PRINT AT 20,31; "f"
2090 LET s$="Amplitudinea"
2100 FOR i=1 TO 12
2110 PRINT AT 4+i,1;s$(i)
2120 BEEP .2,RND*33
2130 NEXT i
2140 LET t$="componentelor"
2150 >FOR i=1 TO 13
2160 PRINT AT 4+i,3;t$(i)
2170 BEEP .2,RND*33
2180 NEXT i
2190 PLOT 130,20: DRAW
     0,100
2200 PAUSE 300
2210 PRINT AT 11,17; "Uo"
2220 PRINT AT 20,15; "fo"
2230 PAUSE 300
2240 PLOT 70,20: DRAW 0,
     m*50
2250 PAUSE 300
2260 IF NOT m=0 THEN
     PRINT AT 17,9; "m.
     Uo/2"; AT 20,6; "fo-fm"
2270 PAUSE 300
2280 PLOT 190,20: DRAW 0,
     m*50
2290 PAUSE 300
2300 IF NOT m=0 THEN
     PRINT AT 17,24; "m.
     Uo/2"; AT 20,21; "fo+
     fm"
2310 PAUSE 300
2320 >IF m=0 THEN PRINT
     AT 21,3;" Nu apar compo-
     nente laterale."
2330 INPUT "Doriti un alt ex-
     emplu?(d/n)"; c$
2340 IF c$="d" THEN GO
     TO 1970
2350 IF c$="n" THEN CLS
2360 IF c$<>"d" AND c$<>
```

```
     "n" THEN  GO TO
     2330
2370 CSIZE 16,24
2380 LET s$="S U C C E S!"
2390 FOR i=1 TO 13
2400 PRINT AT 3,1+i;s$(i)
2410 BEEP .2,RND *33
2420 NEXT i
2430 PAUSE 0
2440 STOP
2450 DRAW 3,-5:  DRAW
     -6,0: DRAW 3,5
2460 RETURN
2470 DRAW -5,3: DRAW  0,
     -6: DRAW 5,3
2480 >RETURN
2490 SAVE "Modulatia" LINE
     10
```

5.1. REFRACȚIA LUMINII („REFRACȚIA")

Șirurile de caractere "REFRACTIA" și "LUMINII" se aranjează, în generic, după direcții diferite, la întîlnirea suprafeței de separație dintre două medii optic transparente.

Folosind un disc optic, un semicilindru transparent, o sursă de lumină și calculatorul, se determină indicele relativ de refracție al mediului din care este făcut semicilindrul în raport cu aerul, se calculează media indicelui de refracție și eroarea standard.

Ultima parte a programului permite determinarea unghiului de refracție și dacă este cazul ($n_2 < n_1$) a unghiului limită. Situația respectivă este prezentată și grafic.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 DATA 127,39,56,55,32,76,
   72,67,67,32,67,46,71,79,73,
   65
90 CSIZE 16,24
100 PRINT FLASH 1;AT 3,5;
   "READY"
110 PAUSE 0: CLS
120 CSIZE 0
130 PAPER 0
140 INK 7: CLS
150 PLOT 10,80: DRAW 240,0
160 LET a$="REFRACTIA"
170 PAUSE 50
180 FOR i=1 TO 9
190 BEEP .1,RND*30
200 PLOT 10*i,180-10*i;a$
   (i)
210 PAUSE 10
220 NEXT i
230 PAUSE 100
240 LET b$="LUMINII"
250 FOR i=1 TO 7
260 BEEP .1,RND*30
270 PLOT 126+16*i,85-8*
   i;b$(i)
280 PAUSE 10
290 NEXT i
300 PAUSE 100
```

```
310 PLOT 20,170: DRAW 90,
    -90
320 PAUSE 100: DRAW 140,
    -70
330 PAUSE 100
340 LET c$="NORMALA"
350 FOR i=1 TO 7
360 BEEP .1,RND *30
370 PLOT 115,180-10 *i ;c$(i)
380 PAUSE 10
390 NEXT i
400 PAUSE 100
410 FOR i=1 TO 15
420 PAUSE 5
430 >PLOT 106,180-i *10 ;" !"
440 NEXT i
450 PAUSE 100
460 PLOT 110,100: DRAW
    -15,-5,PI/4
470 PAUSE 50
480 PLOT 95,115 ; "i" : PAUSE
    50
490 PLOT 110,60: DRAW 15,
    12,PI/3
500 PAUSE 50
510 PLOT 120,60 ;"r" :
    PAUSE 50
520 PLOT 150,150 ;"sin i"
530 PLOT 150,140: DRAW 40,
    0
540 PLOT 150,138 ;"sin r"
550 PLOT 190,144 ;"=n"
560 PLOT 208,141 ;"21"
570 PAUSE 100
580 FOR i=1 TO 16
590 BEEP .1,RND *30
600 PLOT 30+i *10,20 ;z$(i)
610 NEXT i
620 IF CODE z$(13)< >71
    THEN NEW
630 >PAUSE 100
640 BEEP .4,19: BEEP .2,23
650 BEEP .4,28: BEEP .2,26
660 BEEP .4,24: BEEP .2,23
670 BEEP .4,21: BEEP .2,23
680 BEEP .4,24: BEEP .2,26
690 BEEP .4,23: BEEP .2,21
700 BEEP .2,21: BEEP .2,19
710 BEEP .2,23: BEEP .4,26
720 BEEP .2,26
730 FOR i=1 TO 175
740 SCROLL 7
750 NEXT i
760 CLS
770 PRINT AT 5,2 ; "VERIFI-
    CAREA EXPERIMENTA-
    LA"
780 PRINT AT 7,5 ; "A LEGII
    REFRACTIEI"
790 PRINT AT 9,2 ; "SI DE-
    TERMINAREA INDICE-
    LUI"
800 >PRINT AT 11,4 ; "RELA-
    TIV DE REFRACTIE"
810 PRINT AT 15,0 ; "Mijloace
    de invatamint necesare :"
820 PRINT TAB 7 ;"-calcula-
    tor"
830 PRINT TAB 7 ;"-disc
    optic"
840 PRINT TAB 7 ;"-sursa de
    lumina"
850 PAUSE 0: CLS
860 DIM n(9)
870 PRINT TAB 6 ;"i" ; TAB
    12 ;"r" ; TAB 18 ;"n=SIN
    i/SIN r"
880 PRINT "=========
    ==========="
890 FOR k=1 TO 9
900 PRINT AT 21,0 ; "Introdu-
    ceti unghiul i=" ;20+k *5
910 INPUT "Masurati unghiul
    r=" ;r
920 IF r<=0 OR r>90 THEN
    PRINT #0 ;"      "
    GRESALA!
```

```
930>IF r<=0 OR r>90 THEN
    PAUSE 300
940 IF r<=0 OR r>90 THEN
    GO TO 910
950 PRINT AT 1+2*k,6;20+
    k*5;AT1+2*k,12;r;AT
    1+2*k,18;SIN ((25+k*
    5)*PI/180)/SIN (r*PI/
    180)
960 PRINT "----------
    ----------"
970 LET n(k)=SIN ((25+k*5)
    *PI/180)/SIN (r*PI/180)
980 NEXT k
990 LET s=0
1000 FOR k=1 TO 9: LET s=
    s+n(k):NEXT k
1010 PRINT AT 21,0;"  "
1020 LET n=s/9: LET b=0
1030 FOR k=1 TO 9
1040 LET b=b+(ABS (n(k)-n))
    ^2
1050 NEXT k
1060>PRINT AT 21,0;"Media
    este n=";n
1070 PAUSE 0: PRINT AT
    21,0;"  "
1080 LET e=SQR (b/72)
1090 PRINT AT 21,0; "Eroarea
    standard e=";e
1100 PRINT #0; "Deci n=";
    n;"(+/-)";e
1110 PAUSE 0: CLS
1120 PRINT AT 6,4; "SCRIETI
    PE TABLA SI APOI"
1130 PRINT AT 8,2; "ANALI-
    ZATI URMATOARELE
    CAZURI"
1140 PRINT AT 10,9; "DE RE-
    FRACTIE:"
1150 PRINT AT 13,9;"1)n2>n1"
1160 PRINT AT 15,9;"2) n2<n1
    si i<1"
1170 PRINT AT 17,9;"3) n2<n1
    si i>=1"
1180>PRINT AT 19,9;"4) XI,
    139,2"
1190 PAUSE 0: CLS
1200 PLOT 0,90: DRAW 255,0
1210 INPUT "Ce mediu este
    sus?"; a$
1220 PRINT AT 1,17;a$
1230 PRINT AT 2,17;"n1="
1240 INPUT "Ce indice de re-
    fractie are?";n1
1250 IF n1<1 THEN PRINT
    #0;" ,,GRESALA!
1260 IF n1<1 THEN PAUSE 300
1270 IF n1<1 THEN GO TO
    1240
1280 PRINT AT 2,20;n1
1290 INPUT "Ce mediu este
    jos?";b$
1300 PRINT AT 11,0;b$
1310 PRINT AT 12,0;"n2="
1320 INPUT "Ce indice de re-
    fractie are?";n2
1330 PRINT AT 12,3;n2
1340>PRINT AT 3,17;"i="
1350 INPUT "Introduceti i in
    grade!";i
1360 PRINT AT 3,19;i
1370 IF n1<1 OR n2<1 OR
    i>=90 OR i<0 THEN
    PRINT AT 21,6; "Nu are
    sens fizic!"
1380 IF n1<1 OR n2<1 OR
    i>=90 OR i<0 THEN GO
    TO 1190
1390 LET 1=0
1400 IF n2<n1 THEN LET 1=
    ASN (n2/n1)
1410 IF n2<n1 AND i<1*180/
    PI THEN LET r=ASN
    (n1/n2*SIN (i*PI/180))
1420 IF n2>n1 THEN LET r=
```

```
     ASN (n1/n2 * SIN (i * PI/
     180))
1430 IF n2<n1 AND i<1 * 180/
     PI THEN PRINT AT 13,0;
     "r=";r * 180/PI
1440 IF n1<n2 THEN PRINT
     AT 13,0; "r=";r * 180/PI
1450 IF n2<n1 THEN PRINT
     AT 4,17;"1=";1 * 180/PI
1460 IF n2<n1 AND i>=1 *
     180/PI THEN PRINT AT
     21,4; "APARE REFLEXIE
     TOTALA!"
1470 PAUSE 200: FOR y=170
     TO 20 STEP -10
1480 PLOT 130,y: DRAW 0,-5
1490 NEXT y: PAUSE 100
1500 LET im=ATN (3/2) * 180/
     PI
1510 IF i<=im THEN PLOT
     130-80 * TAN (i * PI/180),
     170
1520 IF i<=im THEN DRAW
     80 * TAN (i * PI/180),-80
1530 IF i>im THEN PLOT 10,
     90+120 * TAN (PI/2-i *
     PI/180)
1540 IF i>im THEN DRAW
     120,-120 * TAN (PI/2-i *
     PI/180)
1550 LET rm=ATN (3/2)
1560 IF r<=rm AND n2<n1
     THEN PLOT 130,90
1570 IF r<=rm AND n2>n1
     THEN DRAW 80 * TAN r,
     -80
1580 IF r<=rm AND n1>n2
     AND i<1 * 180/PI THEN
     PLOT 130,90
1590 IF r<=rm AND n1>n2
     AND i<1 * 180/PI THEN
     DRAW 80 * TAN r,-80
1600 IF r>rm AND n2>n1
     THEN PLOT 130,90
1610 IF r>rm AND n2>n1
     THEN DRAW 120,-120 *
     TAN (PI/2-r)
1620 IF r>rm AND n1>n2
     AND i<1 * 180/PI THEN
     PLOT 130,90
1630 IF r>rm AND n1>n2
     AND i<1 * 180/PI THEN
     DRAW 120,-120 * TAN
     (PI/2-r)
1640 IF n2<n1 AND i>=1 *
     180/PI AND i<=im THEN
     PLOT 130,90
1650 IF n2<n1 AND i>=1 *
     180/PI AND i<=im THEN
     DRAW 80 * TAN (i * PI/
     180),80
1660 IF n2<n1 AND i>=1 *
     180/PI AND i>im THEN
     PLOT 130,90
1670 IF n2<n1 AND i>=1 *
     180/PI AND i>im THEN
     DRAW 120, 120 * TAN (PI/
     2-i * PI/180)
1680 GO TO 1190
1690 SAVE "Refractia" LINE 10
```

5.2. LENTILE CONVERGENTE („LENTILA")

Dacă o sursă de lumină punctiformă este plasată în focarul obi ect, lentila convergentă transformă fasciculul divergent într-un fasci cul paralel. Pe de altă parte, lentila convergentă transformă un fasci cul de lumină paralel într-un fasci cul convergent.

Cu instrucțiunea CLS se șterge ecranul pentru a face loc modului de obținere a unei imagini reale dată de o lentilă convergentă. Această imagine este însoțită de relația necesară determinării distanței focale a unei lentile convergente.

După procurarea unor mijloace de învățămînt și efectuarea unor experiențe, calculatorul determină distanța focală a lentilei folosite, calculează media acesteia și eroarea standard.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="LENTILE"
130 FOR i=1 TO 7
140 BEEP .1,RND*30
150 PLOT 45+i*20,120;a$(i)
160 NEXT i
170 LET b$="CONVERGEN-
   TE"
180 FOR i=1 TO 11
190 BEEP .1,RND*30
200 PLOT 65+i*10,100;b$(i)
210 NEXT i
220>PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND*30
250 PLOT 40+i*10,80;z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND*30
300 PLOT 40,156-i*16;"*"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND*30
340 PLOT 40+i*10,60;"*"
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND*30
380 PLOT 210,60+i*16;"*"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND*30
420 PLOT 210-i*10,140;"*"
430 NEXT i
440>DATA 127,39,56,55,32,76,
   72,67,67,32,67,46,71,79,73,
   65
450 PAUSE 50: PLOT 38,142
460 DRAW 0,-100: DRAW
   182,0
470 DRAW 0,100: DRAW
   -182,0
480 PAUSE 100
490 BEEP .4,19: BEEP .2,23
500 BEEP .4,28: BEEP .2,26
510 BEEP .4,24: BEEP .2,23
520 BEEP .4,21: BEEP .2,23
530 BEEP .4,24: BEEP .2,26
540 BEEP .4,23: BEEP .2,21
550 BEEP .2,21: BEEP .2,19
560 BEEP .2,23: BEEP .4,26
570 BEEP .2,26
580 CSIZE 0
590 IF CODE z$(13)<>71
   THEN NEW
600 FOR i=1 TO 175
610 SCROLL 7
620 NEXT i
630 CLS
640>PAPER 0
650 INK 7: CLS
```

```
660 PLOT 60,150: DRAW 0,
    -80
670 GO SUB 2280
680 PLOT 60,150: GO SUB
    2240
690 PAUSE 90
700 FOR x=0 TO 50: FOR
    y=-3 TO 3
710 PLOT x+10,110+y/5*x
720 NEXT y: NEXT x
730 FOR x=60 TO 120
740 FOR y=80 TO 140 STEP
    10
750 PLOT x,y
760 NEXT y: NEXT x
770 PAUSE 80: PLOT 5,100;
    "F1"
780 PAUSE 90
790 LET a$="F1-focar ob-
    iect": LET y=30
800 GO SUB 2320
810 PAUSE 90: PLOT 10,40
820 DRAW 0,20: PLOT 60,40:
    DRAW 0,20
830 >PAUSE 50: PLOT 25,50
840 DRAW -15,0: GO SUB
    2300
850 PAUSE 50: PLOT 45,50
860 DRAW 15,0: GO SUB 2260
870 PAUSE 50: PLOT 30,55;
    "f1"
880 PAUSE 100
890 PLOT 190,150: DRAW 0,
    -80
900 GO SUB 2280
910 PLOT 190,150: GO SUB
    2240
920 PAUSE 90
930 FOR x=130 TO 190
940 FOR y=80 TO 140 STEP
    10
950 PLOT x,y: NEXT y:
      NEXT x
960 FOR x=0 TO 60
970 FOR y=-30 TO 30 STEP
    10
980 PLOT 190+x,110+y-y/50
    *x
990 NEXT y: NEXT x
1000 PAUSE 80
1010 PLOT 235,100;"F2"
1020 PAUSE 90
1030 LET a$="F2-focar ima-
     gine": LET y=15
1040 >GO SUB 2320
1050 PAUSE 90
1060 PLOT 190,40: DRAW 0,20
1070 PLOT 240,40: DRAW 0,20
1080 PAUSE 50: PLOT 205,50
1090 DRAW -15,0: GO SUB
     2300
1100 PAUSE 50: PLOT 225,50
1110 DRAW 15,0: GO SUB 2260
1120 PAUSE 50: PLOT 210,55;
     "f2"
1130.PAUSE 0: CLS
1140 PLOT 0,120: DRAW 255,0
1150 GO SUB 2260
1160 PAUSE 100: PLOT 240,
     115;"x"
1170 PAUSE 100: PLOT 80,120
1180 DRAW 0,50: GO SUB 2240
1190 PLOT 80,120: DRAW 0,
     -50
1200 GO.SUB 2280
1210 PAUSE 100: PLOT 70,115;
     "0"
1220 PAUSE 100: PLOT 36,124;
     " * "
1230 PAUSE 20: PLOT 35,115;
     "F1"
1240 PAUSE 100: PLOT 116,
     124;" * "
1250 PAUSE 20: PLOT 115,135;
     "F2"
1260 >PAUSE 100: PLOT 25,120
1270 DRAW 0,30: GO SUB 2240
1280 PAUSE 100
```

```
1290 PLOT 20,160; "A": PLOT
     20,115;"B"
1300 PAUSE 100
1310 FOR x=25 TO 80
1320 PLOT x,150: PAUSE 5
1330 NEXT x
1340 FOR x=0 TO 145
1350 PAUSE 5
1360 PLOT 80+x,150-110/145
     *x
1370 NEXT x
1380 FOR x=0 TO 200: PAU-
     SE 5
1390 PLOT x+25,150-11/20*x
1400 NEXT x
1410 PAUSE 100: PLOT 225,120
1420 DRAW 0,-80: GO SUB
     2280
1430 PAUSE 100
1440 PLOT 220,35; "A'": PLOT
     220,135;"B'"
1450 PAUSE 100
1460>PLOT 80,45: DRAW 0,10
1470 PLOT 120,45: DRAW 0,10
1480 PLOT 90,50: DRAW -10,0
1490 GO SUB 2300
1500 PLOT 110,50: DRAW 10,0
1510 GO SUB 2260
1520 PAUSE 100: PLOT 95,55;
     "f"
1530 PAUSE 20
1540 PLOT 25,15: DRAW 0,10
1550 PLOT 80,15: DRAW 0,10
1560 PLOT 225,15: DRAW 0,10
1570 PLOT 40,20: DRAW -15,0
1580 GO SUB 2300
1590 PLOT 65,20: DRAW 15,0
1600 GO SUB 2260
1610 PAUSE 100: PLOT 45,25;
     "x1"
1620 PAUSE 100: PLOT 140,20
1630 DRAW -60,0: GO SUB
     2300
1640 PLOT 165,20: DRAW 60,0
1650 GO SUB 2260
1660 PAUSE 100: PLOT 145,25;
     "x2"
1670>PAUSE 100: PLOT 135,
     155; "f"="
1680 PAUSE 100
1690 PLOT 160,150: DRAW 50,0
1700 PAUSE 100: PLOT 165,
     160;"x1.x2"
1710 PAUSE 100: PLOT 165,
     145; "x1-x2"
1720 PAUSE 0: CLS
1730 CSIZE 8,16
1740 LET a$="PENTRU DE-
     TERMINAREA DISTAN-
     TEI": LET y=160
1750 GO SUB 2320
1760 LET a$="FOCALE A
     UNEI LENTILE,SINT"
1770 LET y=140: GO SUB 2320
1780 LET a$="NECESARE
     URMATOARELE:"
1790 LET y=120: GO SUB
     2320
1800 LET a$="-BANC
     OPTIC"
1810 LET y=100: GO SUB 2320
1820 LET a$="-SURSA DE
     LUMINA"
1830>LET y=80: GO SUB 2320
1840 LET a$="-LENTILA
     CONVERGENTA"
1850 LET y=60: GO SUB 2320
1860 LET a$="-ECRAN"
1870 LET y=40: GO SUB 2320
1880 LET a$="-CALCULA-
     TOR"
1890 LET y=20: GO SUB 2320
1900 PAUSE 0
1910 PRINT ;#0; "Le-ati procu-
     rat?"
1920 PAUSE 0: CLS
1930 CSIZE 0
```

```
1940 INPUT "Cite determinari
     efectuati?" ;n
1950 DIM x(n) : DIM y(n) : DIM
     f(n)
1960 PRINT TAB 4 ;"x1" ; TAB
     10 ;"x2" ;TAB 22 ;"f"
1970 PRINT "==========
     =============="
1980 FOR i=1 TO n
1990>INPUT "Introduceti x1
     (cm) !" ;x(i)
2000 IF x(i) >=0 THEN PRINT
     #0 ; "x1 are valori nega-
     tive !"
2010 IF x(i) >=0 THEN PAU-
     SE 200
2020 IF x(i) >=0 THEN GO TO
     1990
2030 PRINT AT 1+2 *i,3 ;x(i)
2040 INPUT "Introduceti x2
     (cm) !" ;y(i)
2050 IF y(i) <=0 THEN PRINT
     #0; "x2 are valori pozi-
     tive !"
2060 IF y(i)<=0 THEN PAU-
     SE 200
2070 IF y(i)<=0 THEN GO TO
     2040
2080 PRINT AT 1+2 *i,10 ;y(i)
2090 LET f(i)=x(i) *y(i)/(x(i)-
     y(i))
2100 PRINT AT 1+2 *i,18 ;f(i)
2110 PRINT "----------
     ----------"
2120 NEXT i
2130 LET s=0
2140 FOR i=1 TO n
2150>LET s=s+f(i) : NEXT i
2160 LET f=s/n : LET b=0
2170 FOR i=1 TO n
2180 LET b=b+(ABS(f(i)-f))^2
2190 NEXT i
2200 LET e=SQR (b/n *(n-1)))
2210 PRINT #1 ;AT 0,0 ; "Me-
     dia aritmetica este f=" ;f ;
     "cm"
2220 PRINT #1 ;AT 1,0 ; "Eroa-
     rea standard e=+/-" ;e ;
     "cm"
2230 PAUSE 0 : STOP
2240 DRAW 2,-5 : DRAW -4,
     0 : DRAW 2,5
2250 RETURN
2260 DRAW -5,2 : DRAW 0,
     -4 : DRAW 5,2
2270 RETURN
2280 DRAW 2,5 : DRAW -4,0 :
     DRAW 2,-5
2290 RETURN
2300 DRAW 5,2 : DRAW 0,-4 :
     DRAW -5,2
2310>RETURN
2320 FOR i=1 TO LEN a$
2330 BEEP .1,RND *30
2340 PLOT 127.5-4 *LEN a$
     +8 *i-8,y ;a$(i)
2350 NEXT i
2360 RETURN
2370 SAVE "Lentila" LINE 10
```

6. FIZICA ATOMICĂ

6.1. MĂSURAREA DIRECTĂ A SARCINII ELECTRICE ELEMENTARE („MILLIKAN")

Programul începe cu o prezentare a dispozitivului Millikan, apoi se trece la imaginea cîmpului vizual al microscopului. În lipsa tensiunii aplicate plăcilor, o picătură de ulei electrizată negativ cade sub acțiunea propriei greutăți avînd o anumită viteză. Aplicînd o tensiune plăcilor, picătura se va mișca în sus.

Lîngă cîmpul vizual al microscopului este reprezentată și schema vectorială a forțelor pentru cele două cazuri

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="MILLIKAN"
130 FOR i=1 TO 8
140 BEEP .1,RND*30
150 PLOT 30+i*20,115;a$(i)
160 NEXT i
170 PAUSE 50
180 FOR i=1 TO 16
190 BEEP .1,RND*30
200 PLOT 35+i*10,85;z$(i)
210 NEXT i
220 PAUSE 50
230 FOR i=1 TO 5
240 BEEP .1,RND*30
250 PLOT 30,140-i*16;"*"
260 NEXT i
270 FOR i=1 TO 18
280 BEEP .1,RND*30
290 PLOT 30+i*10,60;"*"
300 NEXT i
310 FOR i=1 TO 4
320 PLOT 210,60+i*16;"*"
330 BEEP .1,RND*30
340 NEXT i
350 FOR i=1 TO 19
360 BEEP .1,RND*30
370 PLOT 220-i*10,140;"*"
380 NEXT i
390 PAUSE 50: PLOT 25,142
```

```
400 DRAW 0,-98: DRAW
    198,0
410 DRAW 0,98: DRAW -198
    ,0
420 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65

430>PAUSE 100
440 BEEP .4,19: BEEP .2,23
450 BEEP .4,28: BEEP .2,26
460 BEEP .4,24: BEEP .2,23
470 BEEP .4,21: BEEP .2,23
480 BEEP .4,24: BEEP .2,26
490 BEEP .4,23: BEEP .2,21
500 BEEP .2,21: BEEP .2,19
510 BEEP .2,23: BEEP .4,26
520 BEEP .2,26
530 IF CODE z$(13)<>71
    THEN NEW
540 FOR i=1 TO 175
550 SCROLL 7
560 NEXT i
570 CLS
580 PRINT TAB 4; "DISPO-
    ZITIVUL LUI MILLI-
    KAN"
590 PAUSE 100
600 CSIZE 0
610 PLOT 99,130: DRAW -59,
    0
620>DRAW 0,-70: DRAW
    120,0: DRAW 0,30
630 PLOT 101,130: DRAW 59,
    0: DRAW 0,-30
640 PLOT 99,128: DRAW -57,
    0
650 DRAW 0,-66: DRAW 116,
    0: DRAW 0,28
660 PLOT 99,128: DRAW
    -57,0
670 DRAW 0,-66: DRAW
    116,0: DRAW 0,28
680 PLOT 101,128: DRAW 57
    0: DRAW 0,-28
690 PAUSE 100
700 DEF PROC sun
710 FOR i=1 TO 3
720 BEEP .2,30: BEEP .2,35:
    BEEP .2,40
730 NEXT i
740 END PROC
750 PRINT FLASH 1;AT 5,21;
    "I-incinta"
760 PROC sun
770>PRINT FLASH 0;AT
    5,21; "I-incinta"
780 PAUSE 100
790 PLOT 150,90: DRAW 20,0
800 DRAW 0,10: DRAW -20,
    0: DRAW 0,-10
810 PLOT 150,93: DRAW
    -10,0
820 DRAW 0,4: DRAW 10,0
830 PLOT 170,93: DRAW 5,0
840 DRAW 0,4: DRAW -4,0
850 PAUSE 100
860 PRINT FLASH 1;AT 11,
    21; " #INPUT STOP icro-
    scop"
870 PROC sun
880 PRINT FLASH 0;AT 11,
    21; "M-microscop"
890 PAUSE 100
900 CIRCLE 10,100,2: CIRCLE
    10,90,2
910 PLOT 10,102: DRAW 0,18
920 DRAW 60,0: DRAW 0,-10
930 PLOT 10,88: DRAW 0,-18
940>DRAW 60,0: DRAW 0,10
950 PLOT 60,110: DRAW 35,0
960 PLOT 105,110: DRAW 35,0
970 PLOT 60,80: DRAW 80,0
980 PLOT 100,60
990 PRINT FLASH 1;AT 7,17;
    "A"
```

```
1000 PRINT FLASH 1 ;AT 11,17
     "B"
1010 PRINT FLASH 1 ;AT 15,
     14 ; "A si B-placi"
1020 PROC sun
1030 PRINT FLASH 0 ;AT 7,17 ;
     "A"
1040 PRINT FLASH 0 ;AT 11,
     17 ; "B"
1050 PRINT FLASH 0 ;AT 15,
     14 ; "A si B-placi"
1060 PRINT AT 8,0 ;"+"
1070 PRINT AT 11,0 ;"-"
1080 PAUSE 100
1090 PRINT AT 7,9 ;"++"
1100 PRINT AT 7,14 ;"++"
1110 PRINT AT 12,10 ;"-----"
1120 PAUSE 100
1130 PLOT FLASH 1 ;108,107 ;
     "O"
1140 >PRINT FLASH 1 ;AT 8,21
     21 ; "O-orificiu"
1150 PROC sun
1160 PLOT FLASH 0 ;108,107 ;
     "O"
1170 PRINT FLASH 0 ;AT 8,21 ;
     "O-orificiu"
1180 PAUSE 100
1190 PLOT 99,150 : DRAW 2,0
1200 DRAW 0,-32 : DRAW 3,0
1210 DRAW 0,-5 : DRAW -8,0
1220 DRAW 0,5 : DRAW 3,0
1230 DRAW 0,32
1240 PRINT FLASH 1 ;AT 3,13 ;
     "p"
1250 PRINT FLASH 1 ;AT 17,
     12 ;"p-pulverizator"
1260 PROC sun
1270 PRINT FLASH 0 ;AT 3,13 ;
     "p"
1280 PRINT FLASH 0 ;AT 17,
     12 ;"p-pulverizator"
1290 PAUSE 200
1300 FOR x=95 TO 105 STEP 5
1310 PLOT x,105 : NEXT x
1320 >FOR x=90 TO 110 STEP 5
1330 PLOT x,100 : NEXT x
1340 FOR x=85 TO 115 STEP 5
1350 PLOT x,95 : NEXT x
1360 FOR x=80 TO 120 STEP 5
1370 PLOT x,90 : NEXT x
1380 FOR x=75 TO 125 STEP 5
1390 PLOT x,85 : NEXT x
1400 PAUSE 100
1410 PLOT 35,85 : DRAW 0,20
1420 DRAW -15,0 : DRAW 0,
     -20 : DRAW 15,0
1430 PRINT FLASH 1 ;AT 10,3 ;
     "X"
1440 PRINT FLASH 1 ;AT 20,6 ;
     "X-tub de radiatii X"
1450 PROC sun
1460 PRINT FLASH 0 ;AT 10,3 ;
     "X"
1470 PRINT FLASH 0 ;AT 20,6 ;
     "X-tub de radiații X"
1480 PRINT FLASH 0 ;AT 20,6 ;
     "X-tub de radiatii X"
1490 FOR x=35 TO 65 STEP .5
1500 >PLOT x,95+3 * SINE(x/7
     * PI)
1510 NEXT x
1520 PLOT 70,95 : DRAW -5,3
1530 DRAW 0,-6 : DRAW 5,3
1540 PAUSE 0
1550 CLS
1560 PLOT 70,150 : DRAW 180,0
1570 PLOT 70,10 : DRAW 180,0
1580 PAUSE 100
1590 PLOT 80,90 : DRAW 0,60
1600 DRAW 3,-5 : DRAW -6,0
1610 DRAW 3,5 : PLOT 80,70
1620 DRAW 0,-60 : DRAW 3,5
1630 DRAW -6,0 : DRAW 3,-5
1640 PAUSE 100
1650 PRINT FLASH 1 ;AT 11,9 ;
     "U,d"
1660 PROC sun
```

```
1670 PRINT FLASH 0 ;AT 11,9 ;
     "U,d"
1680 PAUSE 100
1690 PRINT FLASH 1 ;AT 0,18 ;
     "U=0"
1700 PROC sun
1710 PRINT FLASH 0 ;AT 0,18 ;
     "U=0"
1720 >PAUSE 100
1730 CIRCLE 160,80,60
1740 PLOT 140,120 : DRAW 40,0
1750 PLOT 140,40 : DRAW 40,0
1760 PLOT 150,80 : DRAW 20,0
1770 FOR y=45 TO 115 STEP 5
1780 PLOT 155,y : DRAW 10,0
1790 NEXT y
1800 PLOT 210,40 : DRAW 30,0
1810 PLOT 210,120 : DRAW 31,0
1820 PLOT 240,70 ; DRAW 0,
     -30
1830 DRAW 3,5 : DRAW -6,0
1840 DRAW 3,-5: PLOT 240,90
1850 DRAW 0,30 : DRAW 3,-5
1860 DRAW -6,0 : DRAW 3,5
1870 PAUSE 100
1880 PLOT FLASH 1 ;236,83 ;"1"
1890 PROC sun
1900 PLOT  FLASH 0 ;236,83 ;
     "1"
1910 PAUSE 100
1920 CIRCLE 20,80,5
1930 PLOT 18,30 : DRAW 4,0
1940 >PAUSE 80
1950 PRINT FLASH 1 ;AT 11,0 ;
     "m"
1960 PROC sun
1970 PRINT FLASH 0 ;AT 11,0 ;
     "m"
1980 PAUSE 100
1990 PRINT FLASH 1 ;AT 11,4 ;
     "q"
2000 PROC sun
2010 PRINT FLASH 0 ;AT 11,4 ;
     "q"
2020 PAUSE 80
2030 PLOT 20,75 : DRAW 0,
     -35
2040 DRAW 3,5 : DRAW -6,0 :
     DRAW 3,-5
2050 PAUSE 100
2060 PRINT FLASH 1 ;AT 15,4 ;
     "G"
2070 PLOT 30,60 : DRAW 10,0
2080 DRAW -5,2 : DRAW 0,
     -4 : DRAW 5,2
2090 PROC sun
2100 PRINT FLASH 0 ;AT 15,4 ;
     "G"
2110 PAUSE 100
2120 PLOT 70,150 : DRAW 180,0
2130 PLOT 70,10 : DRAW 180,0
2140 >PLOT 20,85 : DRAW 0,35
2150 DRAW 3,-5 : DRAW -6,
     0 : DRAW 3,5
2160 PAUSE 100
2170 PRINT FLASH 1 ;AT 9,4 ;
     "R"
2180 PLOT 30,110 : DRAW 10,0
2190 DRAW -5,2 : DRAW 0,
     -4 : DRAW 5,2
2200 PROC sun
2210 PRINT FLASH 0 ;AT 9,4 ;
     "R"
2220 PAUSE 0
2230 POKE 23673,0 : POKE
     23672,0
2240 FOR y=124 TO 45 STEP
     -.3
2250 PLOT 132,y ;"o"
2260 PRINT AT 0,24 ; "t=" ;
     USING "00.0" ; (256 *
     PEEK 23673+PEEK
     23672)/50 ; "s"
2270 NEXT y
2280 PLOT OVER 1 ;132,45 ;"o"
2290 PAUSE 0 : CLS
2300 PLOT 70,150 : DRAW 180,0
```

```
2310 PLOT 70,10 : DRAW 180,0
2320 >PAUSE 100
2330 PRINT FLASH 1 ;AT 2,9 ;
     "+ + + + + + + +"
2340 PRINT FLASH 1 ;AT 21,9 ;
     "− − − − − − − −"
2350 PROC sun
2360 PRINT FLASH 0 ;AT 2,9 ;
     "+ + + + + + + +"
2370 PRINT FLASH 0 ;AT 21,9 ;
     "− − − − − − − −"
2380 PLOT 80,90 : DRAW 0,60
2390 DRAW 3,−5 : DRAW −6,0
2400 DRAW 3,5 : PLOT 80,70
2410 DRAW 0,−60 : DRAW 3,5
2420 DRAW −6,0 : DRAW 3,−5
2430 PAUSE 100
2440 PRINT FLASH 1 ;AT 11,9 ;
     "U,d"
2450 PROC sun
2460 PRINT FLASH 0 ;AT 11,9 ;
     "U,d"
2470 PAUSE 100
2480 CIRCLE 160,80,60
2490 PLOT 140,120 : DRAW 40,0
2500 >PLOT 140,40 : DRAW 40,0
2510 PLOT 150,80 : DRAW 20,0
2520 FOR y=45 TO 115 STEP5
2530 PLOT 155,y : DRAW 10,0
2540 NEXT y
2550 PLOT 210,40 : DRAW 30,0
2560 PLOT 210,120 : DRAW 30,0
2570 PAUSE 100
2580 PLOT 240,70 : DRAW 0,
     −30
2590 DRAW 3,5 : DRAW −6,0
2600 DRAW 3,−5 : PLOT 240,90
2610 DRAW 0,30 : DRAW 3,−5
2620 DRAW −6,0 : DRAW 3,5
2630 PLOT FLASH 1 ;236,84 ;"1"
2640 PROC sun
2650 PLOT FLASH 0 ;236,84 ;"1"
2660 PAUSE 100
2670 CIRCLE 20,80,5
2680 PLOT 18,80 : DRAW 4,0
2690 PAUSE 100
2700 PRINT FLASH 1 ;AT 11,0 ;
     "m"
2710 >PROC sun
2720 PRINT FLASH 0 ;AT 11,0 ;
     "m"
2730 PAUSE 100
2740 PRINT FLASH 1 ;AT 11,4 ;
     "q"
2750 PROC sun
2760 PRINT FLASH 0 ;AT 11,4 ;
     "q"
2770 PAUSE 100
2780 PLOT 20,75 : DRAW 0,−35
2790 DRAW 3,5 : DRAW −6,0 :
     DRAW 3,−5
2800 PAUSE 100
2810 PRINT FLASH 1 ;AT 15,4 ;
     "G"
2820 PLOT 30,60 : DRAW 10,0
2830 DRAW −5,2 : DRAW 0,
     −4 : DRAW 5,2
2840 PROC sun
2850 PRINT FLASH 0 ;AT 15,4 ;
     "G"
2860 PAUSE 100
2870 PLOT 20,85 : DRAW 0,55
2880 DRAW 3,−5 : DRAW −6,
     0 : DRAW 3,5
2890 PAUSE 100
2900 >PRINT FLASH 1 ;AT 5,4 ;
     "Fe"
2910 PLOT 30,140 : DRAW 10,0
2920 DRAW −5,2 : DRAW 0,−4
2930 DRAW 5,2
2940 PROC sun
2950 PRINT FLASH 0 ;AT 5,4 ;
     "Fe"
2960 PAUSE 100
2970 PLOT 20,55 : DRAW 3,5 :
     DRAW −6,0 : DRAW 3,
     −5
2980 PAUSE 100
```

```
2990 PRINT FLASH 1 ;AT 13,4 ;
     "R'"
3000 PLOT 30,74
3010 DRAW 10,0 : DRAW -5,2
3020 DRAW 0,-4 : DRAW 5,2
3030 PROC sun
3040 PRINT FLASH 0 ;AT 13,4 ;
     "R'"
3050 PAUSE 0
3060 POKE 23673,0 : POKE
     23672,0
3070 FOR y=45 TO 124 STEP
     .25
3080 PLOT 132,y ;"o"
3090>PRINT AT 0,18 ; "t=" ;
     USING "00.0" ; (256 *
     PEEK 23673+PEEK
     23672)/50 ; "s"
3100 NEXT y
3110 PLOT OVER 1 ;132,124 ;
     "o"
3120 PAUSE 0
3130 STOP
3140 SAVE "MILLIKAN"
     LINE 10
```

6.2. EXPERIENȚELE LUI E. RUTHERFORD („RUTHERFORD")

În prima parte a programului se prezintă dispozitivul Rutherford, apoi în partea a doua sînt reprezentate traiectoriile unui anumit număr de particule alfa care se deplasează prin apropierea nucleului. Numărul acestora se introduce de către utilizator. Parametrul de ciocnire este creat aleator și apoi afișat în unități arbitrare(ua). Este tipărit și unghiul de împrăștiere, corespunzător parametrului de ciocnire.

```
 10 BORDER 2 : PAPER 6
 20 INK 1 : CLS
 30 DIM z$(16)
 40 FOR i=1 TO 16
 50 READ d
 60 LET z$(i)=CHR$ d
 70 NEXT i
 80 CSIZE 16,24
 90 PRINT FLASH 1 ; AT 3,5 ;
    "READY"
100 PAUSE 0 : CLS
110 CSIZE 8,16
120 LET a$="EXPERIEN-
    TELE"
130 FOR i=1 TO 12
140 BEEP .1,RND *30
150 PLOT 60+i *10,120 ; a$(i)
160 NEXT i
170 LET b$="RUTHER-
    FORD"
180 FOR i=1 TO 10
190 BEEP .1,RND *30
200 PLOT 70+i *10,100 ; b$
    (i)
210 NEXT i
220>PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND *30
250 PLOT 40+i *10,80 ; z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND *30
300 PLOT 40,156-i *16 ; " *"
310 NEXT i
320 FOR i=1 TO 17
```

```
330 BEEP .1,RND *30
340 PLOT 40+i * 10,60 ;" * "
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND *30
380 PLOT 210,60+i * 16 ; " * "
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210-i * 10,140 ; " * "
430 NEXT i
440 >DATA 127,39,56,55,32,76,
  72,67,67,32,67,46,71,79,73,65
450 PAUSE 50
460 PLOT 38,142 : DRAW 0,
    -100
470 DRAW 182,0 : DRAW
    0,100 : DRAW -182,0
480 PAUSE 100
490 BEEP .4,19 : BEEP .2,23
500 BEEP .4,28 : BEEP .2,26
510 BEEP .4,24 : BEEP .2,23
520 BEEP .4,21 : BEEP .2,23
530 BEEP .4,24 : BEEP .2,26
540 BEEP .4,23 : BEEP .2,21
550 BEEP .2,21 : BEEP .2,19
560 BEEP .2,23 : BEEP .4,26
570 BEEP .2,26
580 IF CODE z$(13)< >71
    THEN NEW
590 CSIZE 0
600 FOR i=1 TO 175
610 SCROLL 7
620 NEXT i
630 >CLS
640 DEF PROC sir
650 FOR i=1 TO LEN a$
660 BEEP .1,RND *30
670 PLOT x+i *8,y ;a$(i)
680 NEXT i
690 END PROC
700 DEF PROC e
710 DRAW 48,0 : DRAW
    -4,2
720 DRAW 0,-4 : DRAW 4,2
730 END PROC
740 LET a$="DISPOZITI-
    VUL RUTHERFORD"
750 LET x=24 : LET y=170
760 PROC sir
770 PAUSE 100
780 FOR x=50 TO 180 STEP
    10
790 PLOT x,80 : DRAW 5,0
800 NEXT x
810 PAUSE 100
820 PLOT 70,70 : DRAW
    0,20
830 LET a$="Sursa de"
840 >LET x=0 : LET y=50
850 PROC sir
860 LET a$="particule"
870 LET x=0 : LET y=40
880 PROC sir
890 LET a$="alfa"
900 LET x=0 : LET y=30
910 PROC sir
920 PLOT 20,50 : DRAW 0,20
930 PROC e
940 PAUSE 100
950 PLOT 120,65 : DRAW
    0,30
960 LET a$="Foita de aur"
970 LET x=0 : LET y=120
980 PROC sir
990 PLOT 110,115
1000 DRAW 10,0 : DRAW 0,
     -18
1010 DRAW 2,5 : DRAW -4,0 :
     DRAW 2,-5
1020 PAUSE 100
1030 FOR i=0 TO 2 *PI STEP
     .1
1040 >PLOT OVER 1 ;120+70 *
     COS i,80+70 * SIN i
1050 NEXT i
1060 PAUSE 100
```

```
1070 PLOT 167,150: DRAW
     -10,-10
1080 DRAW 20,-20
1090 DRAW 10,10: DRAW
     -20,20
1100 PAUSE 100: LET a$=
     "Detector"
1110 LET x=180: LET y=150
1120 PROC sir
1130 PAUSE 100
1140 PLOT 70,90: PROC e
1150 PAUSE 50
1160 PLOT 120,90: PROC e
1170 PAUSE 50
1180 PLOT 70,85: PROC e
1190 PAUSE 50: PLOT 120,85
1200 PROC e
1210 PAUSE 50
1220 PLOT 70,80: PROC e
1230 PAUSE 50
1240>PLOT 120,80: DRAW
     40,40
1250 DRAW -3,-6: DRAW
     -3,3: DRAW 6,3
1260 PAUSE 50
1270 PLOT 70,75: PROC e
1280 PAUSE 50
1290 PLOT 120,75: DRAW
     50,-25
1300 DRAW -5,0: DRAW 2,3:
     DRAW 3,-3
1310 PAUSE 50
1320 PLOT 70,70: PROC e
1330 PAUSE 50
1340 PLOT 120,70: DRAW 50,
     -10
1350 DRAW -5,-1: DRAW
     2,4: DRAW 3,-3
1360 PAUSE 50
1370 PLOT 150,80: DRAW
     -8,22,PI/4
1380 PAUSE 50: PLOT 152,105;
     "t"
1390 PAUSE 50
1400 LET a$="t-unghi de im-
     prastiere"
1410>LET x=70: LET y=10
1420 PROC sir
1430 PAUSE 0: CLS
1440 INPUT "Cite particule
     alfa doriti sa urmariti?";
     LINE n$
1450 FOR i=1 TO LEN n$
1460 IF CODE n$(i)<48 OR
     CODE n$(i)>57 THEN
     GO TO 1440
1470 NEXT i
1480 LET n=VAL n$
1490 FOR i=1 TO n
1500 PLOT 126,19; "0"
1510 PAUSE 100
1520 PLOT 105,8; "nucleu"
1530 PAUSE 100
1540 FOR x=10 TO 110 STEP
     20
1550 PLOT x,15: DRAW 10,0
1560 PLOT x+15,15
1570 NEXT x
1580 FOR x=135 TO 235 STEP
     20
1590>PLOT x,15: PLOT x+
     5,15: DRAW 10,0
1600 NEXT x
1610 PAUSE 100
1620 LET p=INT (11+59*
     RND)
1630 FOR x=10 TO 240 STEP
     10
1640 PLOT x,15+p: DRAW 5,0
1650 NEXT x
1660 PAUSE 100
1670 PLOT 20,15: DRAW 0,p
1680 DRAW 2,-4: DRAW
     -4,0: DRAW 2,4
1690 PLOT 20,15: DRAW 2,4
1700 DRAW -4,0: DRAW 2,-4
1710 PLOT 28,19+p/2; "p"
1720 PAUSE 100
```

```
1730 PRINT AT 21,0; "p—
     parametrul de ciocnire"
1740 PAUSE 100
1750 PLOT 0,15+p+p *.122
1760 FOR f=PI/1.02 TO 1.1
     STEP— .07
1770 >LET x=130+p^2/(p *
     SINE(f)/COSE(f)—25 *
     (1/COSE(f)+1))
1780 LET y=15+p^2/(p—25 *
     (1/SINE(f)+COSE(f)/SI-
     NE(f)))
1790 IF x<0 OR x>255 THEN
     GO TO 1810
1800 IF y<175 AND y>p
     THEN DRAW x—PEEK
     23677,y—PEEK 23678
1810 NEXT f
1820 LET x=0
1830 IF p<25 THEN LET
     x=15
1840 PRINT AT 0,x; "Hiper-
     bola"
1850 PAUSE 50
1860 PRINT AT 1,x;"p=";p;
     "ua"
1870 PAUSE 100
1880 PRINT AT 2,x; "t=";
     INT (360/PI *ATN (25/
     p));" grd"
1890 PAUSE 100
1900 PRINT #1; AT 0,0; "t-
     unghiul de imprastiere"
1910 PAUSE 0: CLS
1920 NEXT i
1930 >GO TO 1440
1940 SAVE "RUTHERFORD"
     LINE 10
```

7. FIZICA SOLIDULUI

7.1. CLASIFICAREA CORPURILOR SOLIDE DUPĂ STRUCTURĂ („SOLID")

Se începe cu clasificarea corpurilor solide după structură şi se continuă cu prezentarea defectelor punctiforme şi a defectelor unidimensionale.

```
10 BORDER 2 : PAPER 6
20 INK 1 : CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1; AT
   3,5; "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="CLASIFICA-
    REA"
130 FOR i=1 TO 12
140 BEEP .1,RND *30
150 PLOT 60+i * 10,110 ; a$(i)
160 NEXT i
170 LET b$="SOLIDELOR"
180 FOR i=1 TO 9
190 BEEP .1,RND *30
200 PLOT 75+i * 10,90 ;b$(i)
210 NEXT i
220 >PAUSE 50
230 FOR i=1 TO 16
240 BEEP .1,RND *30
250 PLOT 40+i * 10,70 ; z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND *30
300 PLOT 40,146-i * 16 ; " * "
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND *30
340 PLOT 40+i * 10,50 ; " * "
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND *30
380 PLOT 210,50+i * 16 ; " * "
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210-i * 10,130 ; " * "
430 NEXT i
440 >PAUSE 50
450 PLOT 38,130 : DRAW 0,
    -100
```

```
460 DRAW 184,0: DRAW
    0,100: DRAW -184,0
470 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
480 PAUSE 100
490 BEEP .4,19: BEEP .2,23
500 BEEP .4,28: BEEP .2,26
510 BEEP .4,24: BEEP .2,23
520 BEEP .4,21: BEEP. 2,23
530 BEEP .4,24: BEEP .2,26
540 BEEP .4,23: BEEP .2,21
550 BEEP .2,21: BEEP .2,19
560 BEEP .2,23: BEEP .4,26
570 BEEP .2,26
580 IF CODE z$(13)<>71
    THEN NEW
590 CSIZE 0: PAUSE 100
600 FOR i=1 TO 160:
    SCROLL 7: NEXT i
610 CLS
620 >PRINT "CLASIFICAREA
    CORPURILOR SOLIDE"
630 PAUSE 90
640 PRINT AT 2,4; "1) Cor-
    puri cristaline;"
650 PAUSE 90
660 PRINT AT 4,0; "a) mo-
    nocristaline"
670 PAUSE 90
680 PRINT #0; "o-particula
    structurala (atom, mole-
    cula, ion)"
690 PAUSE 100
700 FOR y=100 TO 60 STEP
    -10
710 FOR x=10 TO 110 STEP
    20
720 CIRCLE x,y,3
730 BEEP.01,RND*33
740 NEXT x
750 NEXT y
760 PAUSE 90
770 PRINT AT 16,0; "Retea
    perfect"; AT 17,2; "ordo-
    nata"
780 >FOR y=120 TO 50
    STEP -70
790 FOR x=1 TO 120 STEP 5
800 PLOT x,y: NEXT x:
    NEXT y
810 FOR x=1 TO 120 STEP
    119
820 FOR y=120 TO 50 STEP
    -5
830 PLOT x,y: NEXT y:
    NEXT x
840 PAUSE 200
850 PRINT AT 5,16; "b) poli-
    cristaline"
860 PAUSE 90
870 FOR y=110 TO 90 STEP
    -20
880 FOR x=140 TO 180 STEP
    10
890 CIRCLE x,y,3
900 BEEP .02,RND*33
910 NEXT x
920 NEXT y
930 PAUSE 60
940 FOR y=110 TO 90 STEP
    -10
950 FOR x=200 TO 240 STEP
    20
960 CIRCLE x,y,3
970 BEEP .02,RND*33
980 NEXT x
990 >NEXT y
1000 PAUSE 60
1010 FOR y=80 TO 60 STEP
     -10
1020 FOR x=140 TO 180
     STEP 20
1030 CIRCLE x,y,3
1040 BEEP .02,RND*33
1050 NEXT x
```

```
1060 NEXT y
1070 PAUSE 60
1080 FOR y=80 TO 60 STEP
     -20
1090 FOR x=200 TO 240 STEP
     10
1100 CIRCLE x,y,3
1110 BEEP .02,RND *33
1120 NEXT x
1130 NEXT y
1140 PAUSE 90
1150 PRINT AT 16,15; "Blo-
     curi orientate"
1160 PRINT AT 17,20; "dife-
     rit"
1170 FOR y=120 TO 50 STEP
     -35
1180 FOR x=130 TO 250 STEP
     5
1190 PLOT x,y
1200>NEXT x: NEXT y
1210 FOR x=130 TO 250 STEP
     60
1220 FOR y=120 TO 50 STEP
     -5
1230 PLOT x,y
1240 NEXT y: NEXT x
1250 PAUSE 90
1260 PRINT AT 19,5; "2)Cor-
     puri amorfe"
1270 PRINT AT 20,0; "(prezin-
     ta doar ordine apropiata)"
1280 PAUSE 0
1290 GO TO 2620
1300 CLS
1310 PRINT TAB 6; "DEFEC-
     TE STRUCTURALE"
1320 PAUSE 90
1330 PRINT AT 2,5; "A) DE-
     FECTE PUNCTIFORME"
1340 PRINT AT 4,2; "Un atom
     isi paraseste locul"
1350 PAUSE 300
1360 FOR y=110 TO 20 STEP
     -30
1370>FOR x=20 TO 140 STEP
     30
1380 CIRCLE x,y,5
1390 BEEP .1,RND *30
1400 NEXT x: NEXT y
1410 PAUSE 90
1420 CIRCLE INVERSE 1;110,
     50,5
1430 BEEP .01,10
1440 PLOT 110,50: DRAW 40,
     -20
1450 PRINT AT 18,19; "VA-
     CANTA"
1460 PAUSE 90
1470 CIRCLE 95,95,5
1480 BEEP .2,20
1490 PLOT 100,95: DRAW 50,0
1500 PRINT AT 9,19; "ATOM"
1510 PRINT AT 10,19; "INTER-
     STITIAL"
1520 PAUSE 0
1530 GO TO 2620
1540 CLS
1550 PRINT TAB 6; "DEFEC-
     TE STRUCTURALE"
1560 PAUSE 90
1570>PRINT AT 2,5; "A) De-
     fecte punctiforme"
1580 PRINT TAB 2; "Un atom
     strain mai mare decit atomii
     de baza ai retelei este intro-
     dus in cristal"
1590 PAUSE 400
1600 PLOT 10,120: DRAW 100,0
1610 PLOT 10,100: DRAW 100,0
     -PI/8
1620 PLOT 10,80: DRAW 100,0,
     -PI/6
1630 PLOT 10,60: DRAW 100,0,
     PI/6
1640 PLOT 10,40: DRAW 100,0,
     PI/8
```

```
1650 PLOT 10,20: DRAW 100,0
1660 PLOT 10,120: DRAW 0,
     -100
1670 PLOT 30,120: DRAW 0,
     -100,PI/8
1680 PLOT 50,120: DRAW 0,
     -100,PI/6
1690 PLOT 70,120: DRAW 0,
     -100.-PI/6
1700>PLOT 90,120: DRAW 0,
     -100,-PI/8
1710 PLOT 110,120: DRAW 0,
     -100
1720 CIRCLE 60,70,5
1730 PAUSE 400
1740 PRINT AT 20,2;"IMPURI-
     TATE"
1750 PRINT AT 21,1;"INTER-
     STITIALA"
1760 PAUSE 90
1770 PLOT 140,120: DRAW
     90,0
1780 PLOT 140,105: DRAW 90,0
1790 PLOT 140,90: DRAW 90,0,
     -PI/8
1800 PLOT 140,75: DRAW 90,0
1810 PLOT 140,60: DRAW 90,0,
     PI/8
1820 PLOT 140,45: DRAW 90,0
1830 PLOT 140,30: DRAW 90,0
1840 PLOT 140,120: DRAW 0,
     -90
1850 PLOT 155,120: DRAW 0,
     -90
1860 PLOT 170,120: DRAW 0,
     -90,PI/8
1870 PLOT 185,120: DRAW 0,
     -90
1880>PLOT 200,120: DRAW 0,
     -90,-PI/8
1890 PLOT 215,120: DRAW 0,
     -90
1900 PLOT 230,120: DRAW 0,
     -90
1910 CIRCLE 185,75,5
1920 PAUSE 90
1930 PRINT AT 20,19; "IMPU-
     RITATE"
1940 PRINT AT 21,17; "SUB-
     STITUTIONALA"
1950 PAUSE 0
1960 GO TO 2620
1970 CLS
1980 PRINT AT 1,6; "DEFEC-
     TE STRUCTURALE"
1990 PRINT "B) Defecte unidi-
     mensionale"
2000 PRINT #0; "DISLOCA-
     TIE MARGINALA"
2010 PAUSE 300
2020 FOR y=100 TO 70 STEP
     -30
2030 FOR x=20 TO 200 STEP
     30
2040 CIRCLE x,y,3
2050>BEEP .05,RND*33
2060 PLOT x,y: DRAW 40,30
2070 NEXT x: NEXT y
2080 FOR y=40 TO 10 STEP
     -30
2090 FOR x=35 TO 185 STEP
     30
2100 PLOT x,y: DRAW 40,30
2110 CIRCLE x,y,3
2120 BEEP .05,RND*30
2130 NEXT x: NEXT y
2140 FOR x=20 TO 200 STEP
     30
2150 PLOT x,100: DRAW 0,
     -30
2160 NEXT x
2170 FOR x=20 TO 80 STEP 30
2180 PLOT x,70: DRAW 15,
     -30
2190 NEXT x
2200 FOR x=140 TO 200 STEP
     30
```

```
2210 PLOT x,70: DRAW -15,
     -30
2220 NEXT x
2230 FOR x=35 TO 185 STEP
     30
2240 PLOT x,40: DRAW 0,-30
2250 NEXT x
2260 PAUSE 0
2270 >GO TO 2620
2280 CLS
2290 PRINT TAB 6; "DEFEC-
     TE STRUCTURALE"
2300 PRINT "B) Defecte unidi-
     mensionale"
2310 PRINT #0; "DISLOCA-
     TIE IN SPIRALA"
2320 PAUSE 200
2330 FOR x=10 TO 100 STEP
     30
2340 PLOT x,120: DRAW 0,
     -90
2350 NEXT x
2360 FOR y=120 TO 30 STEP
     -30
2370 PLOT 10,y: DRAW 90,0
2380 NEXT y
2390 FOR x=100 TO 190 STEP
     30
2400 PLOT x,90: DRAW 0,-90
2410 NEXT x
2420 FOR y=90 TO 0 STEP
     -30
2430 PLOT 100,y: DRAW 90,0
2440 NEXT y
2450 PLOT 70,150: DRAW 180,0
2460 >DRAW 0,-90: DRAW
     -60,-60
2470 PLOT 54,140: DRAW 86,0
2480 DRAW 0,-10: DRAW 90,0
2490 DRAW 0,-90
2500 PLOT 32,130: DRAW 88,0
2510 DRAW 0,-20: DRAW
     90,0: DRAW 0,-90
2520 FOR x=10 TO 100 STEP
     30
2530 PLOT x,120: DRAW 60,30
2540 NEXT x
2550 FOR x=100 TO 180 STEP
     30
2560 PLOT x,90: DRAW 60,60
2570 NEXT x
2580 PLOT 190,60: DRAW 60,60
2590 PLOT 190,30: DRAW 60,60
2600 PLOT 190,90: DRAW 60,60
2610 PAUSE 0
2620 CLS
2630 PRINT TAB 6; "DEFEC-
     TE STRUCTURALE"
2640 PRINT AT 3,3; "A)DE-
     FECTE PUNCTIFORME"
2650 >PRINT AT 5,1; "1)Atom
     interstitial si vacanta"
2660 PRINT AT 7,1; "2)Impuri-
     tate interstitiala si"
2670 PRINT AT 8,3; ""substi-
     tutionala"
2680 PRINT AT 11,3; "B) DE-
     FECTE UNIDIMENSIO-
     NALE"
2690 PRINT AT 13,1; "3)Dislo-
     catie marginala"
2700 PRINT AT 15,1; "4)Dislo-
     catie in spirala"
2710 PRINT AT 19,3; "C)DE-
     FECTE BIDIMENSIONA-
     LE"
2720 PRINT #1,AT 0,5; "Ce
     exemplu doriti?"
2730 PAUSE 0
2740 IF INKEY$="1" THEN
     GO TO 1300
2750 IF INKEY$="2" THEN
     GO TO 1540
2760 >IF INKEY$="3" THEN
     GO TO 1970
2770 IF INKEY$="4" THEN
     GO TO 2280
```

```
2780 IF INKEY$<>"1" OR
     INKEY$<>"2" OR IN-
     KEY$<>"3" OR INKEY
     $<>"4" THEN GO TO
     2620
2790 SAVE "Solid" LINE 10
```

7.2. SEMICONDUCTORI INTRINSECI („INTRINSEC")

La temperaturi joase banda de valență a unui semiconductor este practic complet ocupată, iar cea de conducție, liberă. Datorită agitației termice unii electroni trec în banda de conducție, rămînînd în banda de valență o stare energetică liberă care poartă denumirea de gol. În prezența unui cîmp electric, în banda de conducție apare o conducție electronică și în banda de valență o conducție de goluri.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM z$(16)
40 FOR i=1 TO 16
50 READ d
60 LET z$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1;AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="SEMICONDUC-
    TORI"
130 FOR i=1 TO 14
140 BEEP .1,RND*30
150 PLOT 50+i*10,120;a$(i)
160 NEXT i
170 LET b$="INTRINSECI"
180 FOR i=1 TO 10
190 BEEP .1,RND*30
200 PLOT 70+i*10,100;b$(i)
210 NEXT i
220 >PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND*30
250 PLOT 40+i*10,80;z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND*30
300 PLOT 40,156-i*16;"*"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND.*30
340 PLOT 40+i*10,60;"*"
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND*30
380 PLOT 210,60+i*16;"*"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND*30
420 PLOT 210-i*10,140;"*"
430 NEXT i
440 >PLOT 38,142: DRAW 0,
    -100
450 DRAW 182,0: DRAW 0,
    100: DRAW -182,0
460 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
470 PAUSE 100
480 BEEP .4,19: BEEP .2,23
490 BEEP .4,28: BEEP .2,26
500 BEEP .4,24: BEEP .2,23
```

```
510 BEEP .4,21: BEEP .2,23
520 BEEP .4,24: BEEP .2,26
530 BEEP .4,23: BEEP .2,21
540 BEEP .2,21: BEEP .2,19
550 BEEP .2,23: BEEP .4,26
560 BEEP .2,26
570 IF CODE z$(13)<>71
    THEN NEW
580 FOR i=1 TO 175
590 SCROLL 7
600 NEXT i
610 CSIZE 0: CLS
620>PRINT #0; "Semiconduc-
    tor intrinsec la 0 K"
630 LET a$="IN CAZUL U-
    NUI SEMICONDUCTOR
    CARE"
640 LET y=175: GO SUB 2430
650 LET a$="NU CONTINE
    IMPURITATI SI.SE AF-
    LA"
660 LET y=165: GO SUB 2430
670 LET a$="LA T=0K, NU
    EXISTA PURTATORI
    DE"
680 LET y=155: GO SUB
    2430
690 LET a$="SARCINA LI-
    BERI,DECI SE COMPOR-
    TA"
700 LET y=145: GO SUB 2430
710 LET a$="CA UN IZOLA-
    TOR."
720 LET y=135: GO SUB 2430
730 PAUSE 0
740 PLOT 10,0: DRAW 0,110
750 DRAW 3,-5: DRAW -6,
    0: DRAW 3,5
760 PAUSE 100
770 LET e$="Energia"
780>FOR i= TO 7
790 BEEP .2,RND*35
800 PRINT AT 11+i,0;e$(i)
810 NEXT i
820 PAUSE 100
830 FOR y=100 TO 70 STEP
    -5
840 BEEP .1,40
850 PLOT 20,y: DRAW 60,0
860 NEXT y
870 PAUSE 100
880 FOR y=40 TO 10 STEP
    -5
890 BEEP .1,40
900 PLOT 20,y: DRAW 60,0
910 NEXT y
920 PAUSE 100
930 FOR x=40 TO 60 STEP 20
940 FOR y=40 TO 10 STEP
    -10
950 CIRCLE x,y,2
960 BEEP .1,RND*30
970 NEXT y
980 NEXT x
990 FOR x=50 TO 70 STEP 20
1000>FOR y=35 TO 15 STEP
    -10
1010 CIRCLE x,y,2
1020 BEEP .1,RND*30
1030 NEXT y
1040 NEXT x
1050 PAUSE 200
1060 PLOT 80,71: DRAW 0,28
1070 DRAW 3,-5: DRAW -6,
    0: DRAW 3,5
1080 PLOT 80,71: DRAW 3,5
1090 DRAW -6,0: DRAW 3,-5
1100 PAUSE 200
1110 PRINT AT 10,11;"Bc-
    BANDA DE CONDUCTIE"
1120 PRINT AT 11,16; "(libera)"
1130 PAUSE 200
1140 PLOT 30,41: DRAW 0,28
1150 DRAW 3,-5: DRAW -6,
    0: DRAW 3,5
1160 PLOT 30,41: DRAW 3,5
1170 DRAW -6,0: DRAW 3,-5
1180 PAUSE 200
```

```
1190 >PRINT AT 14,4; "Eg<
     3eV"
1200 PAUSE 200
1210 PRINT AT 15,11; "Bi—
     BANDA INTERZISA"
1220 PAUSE 200
1230 PLOT 80,11: DRAW 0,28
1240 DRAW 3,-5: DRAW -6,
     0: DRAW 3,5
1250 PLOT 80,11: DRAW 3,5
1260 DRAW -6,0: DRAW 3,-5
1270 PAUSE 200
1280 PRINT AT 18,11; "Bv—
     BANDA DE VALENTA"
1290 PRINT AT 19,14; "(com-
     plet ocupata)"
1300 PAUSE 0:CLS
1310 LET a$="LA T>0K
     TREC ELECTRONI IN Bc
     DIN"
1320 LET y=175: GO SUB 2430
1330 LET a$="Bv UNDE SE
     FORMEAZA GOLURI.
     CELE"
1340 LET y=165: GO SUB 2430
1350 >LET a$="DOUA BENZI
     SE TRANSFORMA IN"
1360 LET y=155: GO SUB 2430
1370 LET a$="BENZI PAR-
     TIAL OCUPATE CU"
1380 LET y=145: GO SUB 2430
1390 LET a$="PURTATORI
     DE SARCINA ELECTRI-
     CA"
1400 LET y=135: GO SUB 2430
1410 LET a$="LIBERI."
1420 LET y=125: GO SUB
     2430
1430 PAUSE 0
1440 PRINT #0;"Semiconduc-
     tor intrinsec la T>0K"
1450 PAUSE 200
1460 PLOT 20,110: DRAW 120,0
1470 PLOT 20,70: DRAW 120,0
1480 PLOT 20,50: DRAW 120,0
1490 PLOT 20,10: DRAW 120,0
1500 CIRCLE 40,30,5: BEEP
     .04,40
1510 PLOT 38,30: DRAW 4,0
1520 PLOT 40,28: DRAW 0,4
1530 >PAUSE 60
1540 PLOT 40,35: DRAW 0,49
1550 DRAW 3,-5: DRAW -6,
     0: DRAW 3,5
1560 PAUSE 60
1570 CIRCLE 40,90,5: BEEP
     .04,40
1580 PLOT 38,90: DRAW 4,0
1590 PAUSE 60
1600 CIRCLE 100,30,5: BEEP
     .04,40
1610 PLOT 98,30: DRAW 4,0
1620 PLOT 100,28: DRAW 0,4
1630 PAUSE 60
1640 PLOT 100,35: DRAW 0,49
1650 DRAW 3,-5: DRAW -6,
     0: DRAW 3,5
1660 PAUSE 60
1670 CIRCLE 100,90,5: BEEP
     .04,40
1680 PLOT 98,90: DRAW 4,0
1690 PAUSE 100
1700 PRINT AT 9,5; "Electroni"
1710 >PAUSE 100
1720 PRINT AT 19,6;"Goluri"
1730 PAUSE 100
1740 PRINT AT 10,14;"BANDA
     DE CONDUCTIE"
1750 PAUSE 100
1760 PRINT AT 17,14;"BANDA
     DE VALENTA"
1770 PAUSE 0
1780 PRINT OVER 1;AT 10,14;
     "BANDA DE CONDUC-
     ȚIE";AT 17,14; "BANDA
     DE VALENTA"
1790 PRINT OVER 1; AT 9,5;
```

```
     "Electroni" ;AT 19,6;
     "Goluri"
1800 PLOT 10,10: DRAW 0,100
1810 PLOT 150,10: DRAW 0,100
1820 PLOT INVERSE 1;40,35
1830 DRAW INVERSE 1;0,49
1840 DRAW INVERSE 1;3,-5
1850 DRAW INVERSE 1;-6,0
1860 DRAW INVERSE 1;3,5
1870 PLOT INVERSE 1;100,35
1880>DRAW INVERSE 1;0,49
1890 DRAW INVERSE 1;3,-5
1900 DRAW INVERSE 1;-6,0
1910 DRAW INVERSE 1;3,5
1920 DEF PROC sun
1930 FOR i=1 TO 10
1940 BEEP .1,30: BEEP .1,35:
     BEEP .1,40
1950 NEXT i
1960 END PROC
1970 FOR i=9 TO 19 STEP 3
1980 PRINT FLASH 1; AT i,0;
     "+"
1990 NEXT i
2000 PROC sun
2010 FOR i=9 TO 19 STEP 3
2020 PRINT FLASH 0; AT i,0;
     "+"
2030 NEXT i
2040 FOR i=9 TO 19 STEP 3
2050 PRINT FLASH 1;AT i,19;
     "_"
2060 NEXT i
2070 PROC sun
2080 FOR i=9 TO 19 STEP 3
2090>PRINT FLASH 0; AT i,
     19;"-"
2100 NEXT i
2110 PAUSE 100
2120 CIRCLE 75,30,5: BEEP
     .04,40
2130 PLOT 73,30: DRAW 4,0
2140 PAUSE 100
2150 CIRCLE 135,30,5: BEEP
     .04,40
2160 PLOT 133,30: DRAW 4,0
2170 PAUSE 100
2180 PLOT 35,90: DRAW -15,0
2190 DRAW 5,3: DRAW 0,-6:
     DRAW -5,3
2200 PAUSE 100
2210 PLOT 95,90: DRAW -15,0
2220 DRAW 5,3: DRAW 0,-6:
     DRAW -5,3
2230 PAUSE 100
2240 PLOT 45,30: DRAW 15,0
2250 DRAW -5,3: DRAW 0,
     -6: DRAW 5,3
2260 PLOT 105,30: DRAW 15,0
2270>DRAW -5,3: DRAW 0,
     -6: DRAW 5,3
2280 PAUSE 100
2290 PLOT 75,23: DRAW -35,
     0,-PI/1.5
2300 DRAW 5,-1: DRAW -4,
     -4: DRAW 1,5
2310 PAUSE 100
2320 PLOT 135,23: DRAW
     -35,0,-PI/1.5
2330 DRAW 5,-1: DRAW -4,
     -4: DRAW 1,5
2340 PAUSE 200
2350 PRINT AT 9,21; "Conduc-
     tie"
2360 PRINT AT 10,21; "electro-
     nica"
2370 PRINT AT 11,21;"in Bc"
2380 PAUSE 200
2390 PRINT AT 17,21;"Conduc-
     tie"
2400 PRINT AT 18,21;"de go-
     luri"
2410 PRINT AT 19,21;"in Bv"
2420 PAUSE 0: STOP
2430>FOR i=1 TO LEN a$
```

```
2440 BEEP .03,RND *30
2450 PLOT 127.5-4 *LEN a$+
     8 *i-8,y ;a$(i)
2460 NEXT i
2470 RETURN
2480 SAVE "Intrinsec" LINE 10
```

7.3. SEMICONDUCTORI EXTRINSECI („EXTRINSEC")

După o descriere a modului de obținere a semiconductorilor de tip n și p, sînt reprezentate benzile de valență și de conducție, între care este situat nivelul donorilor, respectiv al acceptorilor. Trecerea electronilor de pe nivelul donorilor în banda de conducție, respectiv din banda de valență pe nivelul acceptorilor, duce la apariția de purtători mobili de sarcină.

```
 10 BORDER 2 : PAPER 6
 20 INK 1 : CLS
 30 DIM z$(16)
 40 FOR i=1 TO 16
 50 READ d
 60 LET z$(i)=CHR$ d
 70 NEXT i
 80 CSIZE 16,24
 90 PRINT FLASH 1 ; AT 3,5 ;
    "READY"
100 PAUSE 0 : CLS
110 CSIZE 8,16
120 LET a$="SEMICONDUC-
    TORI"
130 FOR i=1 TO 14
140 BEEP .1,RND *30
150 PLOT 50+i *10,120 ; a$(i)
160 NEXT i
170 LET b$="EXTRINSECI"
180 FOR i=1 TO 10
190 BEEP .1,RND *30
200 PLOT 70+i *10,100 ; b$(i)
210 NEXT i
220>PAUSE 100
230 FOR i=1 TO 16
240 BEEP .1,RND *30
250 PLOT 40+i *10,80 ;z$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND *30
300 PLOT 40,156-i *16 ;" *"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND *30
340 PLOT 40+i *10,60 ;" *"
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND *30
380 PLOT 210,60+i *16 ;" *"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210-i *10,140 ;" *"
430 NEXT i
440>PLOT 38,142 : DRAW 0,
    -100
450 DRAW 182,0 : DRAW 0,
    100 : DRAW -182,0
460 PAUSE 100
470 DATA 127,39,56,55,32,76,
    72,67,67,32,67,46,71,79,73,
    65
480 BEEP .4,19 : BEEP .2,23
490 BEEP .4,28 : BEEP .2,26
500 BEEP .4,24 : BEEP .2,23
```

```
510 BEEP .4,21 : BEEP .2,23
520 BEEP .4,24 : BEEP .2,26
530 BEEP .4,23 : BEEP .2,21
540 BEEP .2,21 : BEEP .2,19
550 BEEP .2,23 : BEEP .4,26
560 BEEP .2,26
570 IF CODE z$(13)<>71
    THEN NEW
580 CSIZE 0
590 FOR i=1 TO 175
600 SCROLL 7
610 NEXT i
620 CLS
630 >PRINT #0; "SEMICON-
    DUCTOR DE TIP n"
640 PAUSE 100
650 LET a$="SEMICONDUC-
    TORII DE TIP n SE"
660 LET y=170 : GO SUB 3570
670 LET a$="OBTIN PRIN
    INTRODUCEREA DE"
680 LET y=160 : GO SUB 3570
690 LET a$="IMPURITATI
    DONOARE (DONORI)"
700 LET y=150 : GO SUB 3570
710 LET a$="IN RETEAUA
    CRISTALINA A"
720 LET y=140 : GO SUB 3570
730 LET a$="SEMICONDUC-
    TORULUI, CARE DAU"
740 LET y=130 : GO SUB 3570
750 LET a$="NIVELE
    ENERGETICE MAI A-
    APROPIATE"
760 LET y=120 : GO SUB 3570
770 >LET a$="DE BANDA
    DE CONDUCTIE. ENER-
    GIA DE"
780 LET y=110 : GO SUB 3570
790 LET a$="IONIZARE A
    DONORILOR Ed ESTE"
800 LET y=100 : GO SUB 3570
810 LET a$="MICA, ASTFEL
    CA ELECTRONII POT FI".
820 LET y=90 : GO SUB 3570
830 LET a$="TRANSFERA-
    TI USOR DE PE NIVE-
    LUL"
840 LET y=80 : GO SUB 3570
850 LET a$="DONORILOR
    IN BANDA DE CONDUC-
    TIE"
860 LET y=70 : GO SUB 3570
870 LET a$="IN ACEST FEL
    CONDUCTIA VA FI"
880 LET y=60 : GO SUB 3570
890 LET a$="DETERMINA-
    TA IN SPECIAL DE"
900 LET y=50 : GO SUB 3570
910 >LET a$="ELECTRONII
    DIN Bc PROVENITI DE"
920 LET y=40 : GO SUB 3570
930 LET a$="PE NIVELUL
    DONORILOR, ELECTRO-
    NII"
940 LET y=30 : GO SUB 3570
950 LET a$="FIIND PURTA-
    TORI MAJORITARI IAR"
960 LET y=20 : GO SUB 3570
970 LET a$="GOLURILE
    MINORITARI (nn>>pn).'
980 LET y=10 : GO SUB 3570
990 PAUSE 0 : CLS
1000 PRINT #0; "SEMICON-
     DUCTOR DE TIP n"
1010 GO SUB 3310
1020 PRINT AT 12,3 ;"Eg"
1030 PLOT 20,95 : DRAW 230,0
1040 PAUSE 200
1050 PRINT AT 11,25; "NIVEL"
1060 PRINT AT 12,23 ; "ENER-
     GETIC"
1070 PRINT AT 13,26 ;"AL"
1080 >PRINT AT 14,23 ;"DONO-
     RILOR"
1090 PAUSE 200
1100 PLOT 180,96 : DRAW 0,13
1110 GO SUB 3230
```

```
1120 PLOT 180,96: GO SUB
     3250
1130 PAUSE 100
1140 PRINT AT 8,23;"Ed":
     PAUSE 100
1150 PRINT AT 3,23; "ENER-
     GIA"
1160 PRINT AT 4,26;"DE"
1170 PRINT AT 5,23;"IONIZA-
     RE"
1180 PAUSE 100
1190 PLOT 220,120: DRAW 0,
     -15
1200 DRAW -15,0: DRAW 5,3
1210 DRAW 0,-6: DRAW -5,3
1220 PAUSE 100
1230 GO SUB 3300
1240 PLOT 20,100: GO SUB
     3270
1250 PLOT 25,97: DRAW 0,-4
1260 PLOT 25,100: DRAW 0,29
1270 GO SUB 3230
1280 CIRCLE 25,135,5
1290>PLOT 23,135: DRAW 4,0
1300 PAUSE 100
1310 GO SUB 3300
1320 PLOT 40,100: GO SUB
     3270
1330 PLOT 45,97: DRAW 0,-4
1340 PLOT 45,100: DRAW 0,29
1350 GO SUB 3230
1360 CIRCLE 45,135,5
1370 PLOT 43,135: DRAW 4,0
1380 PAUSE 100
1390 GO SUB 3300
1400 CIRCLE 65,35,5
1410 PLOT 63,35: DRAW 4,0
1420 PLOT 65,37: DRAW 0,-4
1430 PLOT 65,40: DRAW 0,89
1440 GO SUB 3230
1450 CIRCLE 65,135,5
1460 PLOT 63,135: DRAW 4,0
1470 PRINT AT 17,9;"gol"
1480 PAUSE 100
1490 GO SUB 3300
1500 PLOT 80,100: GO SUB
     3270
1510>PLOT 85,97: DRAW 0,-4
1520 PLOT 85,100: DRAW 0,29
1530 GO SUB 3230
1540 CIRCLE 85,135,5
1550 PLOT 83,135: DRAW 4,0
1560 PAUSE 100
1570 GO SUB 3300
1580 PLOT 100,100: GO SUB
     3270
1590 PLOT 105,97: DRAW 0,-4
1600 PLOT 105,100: DRAW 0,29
1610 GO SUB 3230
1620 CIRCLE 105,135,5
1630 PLOT 103,135: DRAW 4,0
1640 PAUSE 100
1650 GO SUB 3300
1660 CIRCLE 125, 35,5
1670 PLOT 123, 35: DRAW 4,0
1680 PLOT 125,37: DRAW 0,-4
1690 PRINT AT 17,17;"gol"
1700 PLOT 125,40: DRAW 0,89
1710 GO SUB 3230
1720 CIRCLE 125, 135,5
1730>PLOT 123,135: DRAW 4,0
1740 PAUSE 100
1750 GO SUB 3300
1760 PLOT 140,100: GO SUB
     3270
1770 PLOT 145,97: DRAW 0,-4
1780 PLOT 145,100: DRAW 0,29
1790 GO SUB 3230
1800 CIRCLE 145,135,5
1810 PLOT 143,135: DRAW 4,0
1820 PAUSE 100
1830 GO SUB 3300
1840 PLOT 160,100: GO SUB
     3270
1850 PLOT 165,97: DRAW 0,-4
1860 PLOT 165,100: DRAW 0,29
1870 GO SUB 3230
1880 CIRCLE 165,135,5
```

```
1890 PLOT 163,135: DRAW 4,0
1900 FOR a=0 TO 120 STEP 60
1910 FOR x=21 TO 41 STEP 20
1920 PLOT INVERSE 1;x+a,95
1930 DRAW INVERSE 1;2,0
1940 PLOT INVERSE 1;x+a+
     6,95
1950>DRAW INVERSE 1;2,0
1960 NEXT x
1970 NEXT a
1980 PAUSE 0: CLS
1990 PRINT #0; "SEMICON-
     DUCTOR DE TIP p"
2000 LET a$="SEMICONDUC-
     TORII DE TIP p SE"
2010 LET y=160: GO SUB 3570
2020 LET a$="OBTIN PRIN
     INTRODUCEREA DE"
2030 LET y=150: GO SUB 3570
2040 LET a$="IMPURITATI
     ACCEPTOARE(ACCEPTO-
     RI)"
2050 LET y=140: GO SUB 3570
2060 LET a$="IN RETEAUA
     CRISTALINA A"
2070 LET y=130: GO SUB 3570
2080 LET a$="SEMICONDUC-
     TORULUI, CARE DAU"
2090 LET y=120: GO SUB 3570
2100>LET a$="NIVELE
     ENERGETICE MAI
     APROPIATE"
2110 LET y=110: GO SUB 3570
2120 LET a$="DE BANDA DE
     VALENTA .ACESTE"
2130 LET y=100: GO SUB 3570
2140 LET a$="NIVELE POT
     PRIMII USOR ELECTRO-
     NI"
2150 LET y=90: GO SUB 3570
2160 LET a$="DIN Bv CRE-
     IND ACOLO GOLURI."
2170 LET y=80: GO SUB 3570
2180 LET a$=ENERGIA MI-
     NIMA NECESARA TRE-
     CERII"
2190 LET y=70: GO SUB 3570
2200 LET a$="ELECTRONI-
     LOR DIN Bv PE NIVE-
     LUL"
2210 LET y=60: GO SUB 3570
2220 LET a$="ACCEPTORI-
     LOR ESTE E a.IN ACEST"
2230 LET y=50: GO SUB 3570
2240>LET a$= "CAZ GOLU-
     RILE SINT PURTATORI"
2250 LET y=40: GO SUB 3570
2260 LET a$="MAJORITARI
     IAR ELECTRONII"
2270 LET y=30: GO SUB 3570
2280 LET a$="PURTATORI
     MINORITARI DE SAR-
     CINA"
2290 LET y=20: GO SUB 3570
2300 LET a$= "(pp>>np)."
2310 LET y=10: GO SUB 3570
2320 PAUSE 0: CLS
2330 PRINT #0; "SEMICON-
     DUCTOR DE TIP p"
2340 GO SUB 3310
2350 PRINT AT 9,3; "Eg"
2360 PLOT 20,75: DRAW 230,0
2370 PAUSE 100
2380 PRINT AT 7,25; "NIVEL"
2390 PRINT AT 8,23; "ENER-
     GETIC"
2400 PRINT AT 9,27; "AL"
2410>PRINT AT 10,20; "AC-
     CEPTORILOR"
2420 PAUSE 100
2430 PLOT 180,61: DRAW
     0,14
2440 GO SUB 3230
2450 PLOT 180,61: GO SUB
     3250
2460 PAUSE 100
2470 PRINT AT 13,23; "Ea"
2480 PAUSE 100
```

```
2490 GO SUB 3300
2500 CIRCLE 25,35,5
2510 PLOT 23,35: DRAW 4,0
2520 PLOT 25,37: DRAW 0,-4
2530 PLOT 25,40: DRAW 0,29
2540 GO SUB 3230
2550 PLOT 20,80: GO SUB 3270
2560 PAUSE 100
2570 GO SUB 3300
2580 CIRCLE 45,35,5
2590 PLOT 43,35: DRAW 4,0
2600 PLOT 45,37: DRAW 0,-4
2610 PLOT 45,40: DRAW 0,29
2620 >GO SUB 3230
2630 PLOT 40,80: GO SUB 3270
2640 PAUSE 100
2650 GO SUB 3300
2660 CIRCLE 65,35,5
2670 PLOT 63,35: DRAW 4,0
2680 PLOT 65,37: DRAW 0,-4
2690 PLOT 65,40: DRAW 0,89
2700 GO SUB 3230
2710 CIRCLE 65,135,5
2720 PLOT 63,135: DRAW 4,0
2730 PAUSE 100
2740 GO SUB 3300
2750 CIRCLE 85,35,5
2760 PLOT 83,35: DRAW 4,0
2770 PLOT 85,37: DRAW 0,-4
2780 PLOT 85,40: DRAW 0,29
2790 GO SUB 3230
2800 PLOT 80,80: GO SUB 3270
2810 PAUSE 100
2820 GO SUB 3300
2830 CIRCLE 105,35,5
2840 >PLOT 103,35: DRAW 4,0
2850 PLOT 105,37: DRAW 0,-4
2860 PLOT 105,40: DRAW 0,29
2870 GO SUB 3230
2880 PLOT 100,80: GO SUB
     3270
2890 PAUSE 100
2900 GO SUB 3300
2910 CIRCLE 125,35,5
2920 PLOT 123,35: DRAW 4,0
2930 PLOT 125,37: DRAW 0,-4
2940 PLOT 125,40: DRAW 0,89
2950 GO SUB 3230
2960 CIRCLE 125,135,5
2970 PLOT 123,135: DRAW 4,0
2980 PAUSE 100
2990 GO SUB 3300
3000 CIRCLE 145,35,5
3010 PLOT 143,35: DRAW 4,0
3020 PLOT 145,37: DRAW 0,-4
3030 PLOT 145,40: DRAW 0,29
3040 GO SUB 3230
3050 PLOT 140,80: GO SUB
     3270
3060 >PAUSE 100
3070 GO SUB 3300
3080 CIRCLE 165,35,5
3090 PLOT 163,35: DRAW 4,0
3100 PLOT 165,37: DRAW 0,-4
3110 PLOT 165,40: DRAW 0,29
3120 GO SUB 3230
3130 PLOT 160,80: GO SUB
     3270
3140 FOR a=0 TO 120 STEP 60
3150 FOR x=21 TO 41 STEP 20
3160 PLOT INVERSE 1; x+a,
     75
3170 DRAW INVERSE 1; 2,0
3180 PLOT INVERSE 1; x+a+
     6,75
3190 DRAW INVERSE 1; 2,0
3200 NEXT x
3210 NEXT a
3220 PAUSE 0: STOP
3230 DRAW 3,-5: DRAW
     -6,0: DRAW 3,5
     RETURN
3250 DRAW 3,5: DRAW -6,0:
     DRAW 3,-5
3260 >RETURN
3270 DRAW 10,0: DRAW 0,
     -10
```

```
3280 DRAW -10,0: DRAW
     0,10
3290 RETURN
3300 BEEP .1,30: RETURN
3310 LET e$="Energia"
3320 FOR i=1 TO 7
3330 BEEP .2,RND*30
3340 PRINT AT 2+2*i,0; e$(i)
3350 NEXT i
3360 PAUSE 100
3370 PLOT 10,0: DRAW 0,170
3380 GO SUB 3230
3390 PAUSE 60
3400 FOR y=10 TO 160 STEP
     50
3410 FOR y=10 TO 160 STEP
     50
3420 PLOT 20,y: DRAW 160,0
3430 NEXT y
3440 PLOT 20,162: DRAW
     160,0
3450 PLOT 20,112: DRAW
     160,0
3460 PLOT 20,58: DRAW 160,0
3470 PLOT 20,12: DRAW 160,0
3480 >PAUSE 100
3490 PRINT AT 2,3; "BANDA
     DE CONDUCTIE"
3500 PAUSE 100
3510 PRINT AT 19,3; "BAN-
     DA DE VALENTA"
3520 PAUSE 100
3530 PLOT 20,61: DRAW 0,48
3540 GO SUB 3230
3550 PLOT 20,61: GO SUB
     3250
3560 RETURN
3570 FOR i=1 TO LEN a$
3580 BEEP .02,RND*30
3590 PLOT 127.5-4*LEN
     a$+8*i-8,y ;a$(i)
3600 NEXT i
3610 RETURN
3620 SAVE "Extrinsec" LINE
     10
```

8. FIZICA NUCLEULUI

8.1. ENERGIA NUCLEARĂ („ENUC")

Deoarece programele prezentate în această culegere au un scop didactic, am insistat asupra reprezentărilor grafice și simulărilor. Programul intitulat „Energia nucleară" face excepție, fiind util exclusiv în efectuarea unor calcule. Valorile cu care se operează în această parte a fizicii nucleare sînt formate dintr-un număr mare de cifre și calculele sînt neplăcute.

Programul prezintă următoarele opțiuni de calcul:

1. energia de legătură a nucleului și energia de legătură medie pe nucleon;
2. energia de legătură a unei particule în nucleu și înălțimea barierei de potențial;
3. energia de reacție și energia prag.

În cazul 2, după efectuarea calculelor se tipărește starea în care se află nucleul (stabilă, metastabilă sau nestabilă), iar în cazul 3, tipul reacției (exoenergetică sau endoenergetică).

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 DIM u$(16)
40 FOR i=1 TO 16
50 READ d
60 LET u$(i)=CHR$ d
70 NEXT i
80 CSIZE 16,24
90 PRINT FLASH 1; AT 3,5;
   "READY"
100 PAUSE 0: CLS
110 CSIZE 8,16
120 LET a$="ENERGIA"
130 FOR i=1 TO LEN a$
140 BEEP .1,RND *30
150 PLOT 45+i *20,120; a$(i)
160 NEXT i
170 LET b="NUCLEARA"
180 FOR i=1 TO LEN b$
190 BEEP .1,RND *30
200 PLOT 45+i *18,100 ;b$(i)
210 NEXT i
220>PAUSE 100
230 FOR i=1 TO 16
```

```
240 BEEP .1,RND *30
250 PLOT 40+i *10,80 ;u$(i)
260 NEXT i
270 PAUSE 50
280 FOR i=1 TO 6
290 BEEP .1,RND *30
300 PLOT 40,156-i *16 ;" *"
310 NEXT i
320 FOR i=1 TO 17
330 BEEP .1,RND *30
340 PLOT 40+i *10,60 ; " *"
350 NEXT i
360 FOR i=1 TO 5
370 BEEP .1,RND *30
380 PLOT 21,60+i *16 ; " *"
390 NEXT i
400 FOR i=1 TO 16
410 BEEP .1,RND *30
420 PLOT 210-i *10,140 ; " *"
430 NEXT i
440 >PLOT 38,142 : DRAW 0,
    -100
450 DRAW 182,0 : DRAW
    0,100
460 DRAW -182,0
470 PAUSE 100
480 DATA 127,39,56,55,32,76,
    72
490 DATA 67,67,32,67,46,71,79
500 DATA 73,65
510 BEEP .4,19 : BEEP .2,23
520 BEEP .4,28 : BEEP .2,26
530 BEEP .4,24 : BEEP .2,23
540 BEEP .4,21 : BEEP .2,23
550 BEEP .4,24 : BEEP .2,26
560 BEEP .4,23 : BEEP .2,21
570 BEEP .2,21 : BEEP .2,19
580 BEEP .2,23 : BEEP .4,26
590 BEEP .2,26
600 IF CODE u$(13)<>71
    THEN NEW
610 FOR i=1 TO 175
620 SCROLL 7
630 NEXT i
640 CLS
650 >LET mH=1.007825
660 LET mn=1.008665
670 LET ep=8.856e-12
680 LET e=1.602e-19
690 PRINT AT 1,4; "Ce doriti
    sa calculati?"
700 PRINT '
710 PRINT AT 3,3; "1) Ener-
    gia de legatura a"
720 PRINT AT 4,6; "nucleului"
730 PRINT AT 6,3; "2) Ener-
    gia de legatura a"
740 PRINT AT 7,6; "unei par-
    ticule in nucleu"
750 PRINT AT 9,3; "3) Ener-
    gia de reactie"
760 PAUSE 0
770 IF INKEY$="1" THEN
    GO TO 810
780 IF INKEY$="2" THEN
    GO TO 1210
790 >IF INKEY$="3" THEN
    GO TO 2070
800 IF INKEY$<>"1" OR
    INKEY$<>"2" OR IN-
    KEY$<>"3" THEN GO
    TO 690
810 CLS
820 PRINT "Energia de lega-
    tura a nucleului:"
830 PRINT AT 2,3; "W =[Z.m
    +(A-Z).m -M] .c"
840 PLOT CSIZE 0; 32,130;
    "leg H n A"
850 PLOT CSIZE 0;225,147;
    "2"
860 CSIZE 8,16
870 PRINT AT 10,0; "Introdu-
    ceti numarul atomic Z!"
880 INPUT LINE Z$
890 FOR i=1 TO LEN Z$
900 IF CODE Z$(i)<48 OR
```

```
     CODE Z$(i) >57 THEN GO
     TO 880
910 NEXT i
920 LET Z=VAL Z$
930 >PRINT AT 10,0; "Intro-
     duceti numarul de masa A!"
940 INPUT LINE A$
950 FOR i=1 TO LEN A$
960 IF CODE A$(i)<48 OR
     CODE A$(i) >57 THEN
     GO TO 940
970 NEXT i
980 LET A=VAL A$
990 PRINT AT 10,0; "Intro-
     duceti masa atomica MA!
1000 INPUT LINE M$
1010 FOR i=1 TO LEN M$
1020 IF CODE M$(i)<46 OR
     CODE M$(i) >57 THEN
     GO TO 1000
1030 IF CODE M$(i)=47 THEN
     GO TO 1000
1040 NEXT i
1050 PRINTAT 10,0;"  "
1060 LET M=VAL M$
1070 LET W=(Z*mH+(A-Z)
     *mn-M)*931.5
1080 >PRINT AT 4,6; "W=";
     USING "000.000"; W;
     "MeV"
1090 PLOT CSIZE 0,58,100;
     "leg"
1100 PAUSE 100
1110 PRINT CSIZE 8,16; AT
     6,0; "Energia de legatura
     pe nucleon:"
1120 PRINT AT 8,2; "B="
1130 PLOT 33,53;"-----"
1140 PLOT 35,58; "W"
1150 PLOT CSIZE 0; 43,50;
     "leg"
1160 PLOT 48,36; "A"
1170 CSIZE 8,16
1180 PRINT AT 8,9; "=";
     USING "00.000"; W/A;
     "MeV/nucleon"
1190 PAUSE 0: CLS
1200 GO TO 690
1210 CLS
1220 PRINT "Energia de lega-
     tura a unei"
1230 PRINT "particule in nuc-
     leu(N-> a+X)"
1240 >PLOT 48,138; "W=
     (m+m-m).c"
1250 PLOT CSIZE 0;65,126;
     "leg"
1260 PLOT CSIZE 0;112,126;
     "a"
1270 PLOT CSIZE 0;136,126;
     "X"
1280 PLOT CSIZE 0;160,126;
     "N"
1290 PLOT CSIZE 0;65,141;
     "a"
300 PLOT CSIZE 0;192,141;
     "2"
1310 INPUT "Masa particulei
     a?";LINE f$
1320 FOR i=1 TO LEN f$
1330 IF CODE f$(i)<46 OR
     CODE f$(i) >57 THEN
     GO TO 1310
1340 IF CODE f$(i)=47 THEN
     GO TO 1310
1350 NEXT i
1360 LET ma=VAL f$
1370 INPUT "Masa nucleului
     X?"; LINE g$
1380 FOR i=1 TO LEN g$
1390 IF CODE g$(i)<46 OR
     CODE g$(i)>57 THEN
     GO TO 1370
1400 >IF CODE g$(i)=47
     THEN GO TO 1370
1410 NEXT i
1420 LET mX=VAL g$
```

```
1430 INPUT "Masa nucleului
     N?"; LINE h$
1440 FOR i=1 TO LEN g$
1450 IF CODE h$(i)<46 OR
     CODE h$(i)>57 THEN
     GO TO 1430
1460 IF CODE h$(i)=47 THEN
     GO TO 1430
1470 NEXT i
1480 LET mN=VAL h$
1490 LET W=(ma+mX-mN)
     *931.5
1500 PRINT CSIZE 8,16; AT
     4,7; "W="; USING
     "000.000"; W;" MeV"
1510 PRINT AT 6,0; "Inalti-
     mea barierei de potential:"
1520 KEYWORDS 0
1530 LET i=USR "p"
1540 POKE i+0,BIN 0
1550 POKE i+1,BIN 11111111
1560>POKE i+2,BIN 0
1570 POKE i+3,BIN 00100100
1580 POKE i+4,BIN 00100100
1590 POKE i+5,BIN 00100100
1600 POKE i+6,BIN 00100100
1610 POKE i+7,BIN 0
1620 LET i=USR "e"
1630 POKE i+0,BIN 0
1640 POKE i+1,BIN 0
1650 POKE i+2,BIN 00011110
1660 POKE i+3,BIN 00100000
1670 POKE i+4,BIN 00011100
1680 POKE i+5,BIN 00100000
1690 POKE i+6,BIN 00011110
1700 POKE i+7, BIN 0
1710 PRINT AT 8,1;"C="
1720 PLOT 28,53; "————"
1730 PLOT 0,60; "Z. Z. e"
1740 PLOT CSIZE 0; 38,49; "a"
1750 PLOT CSIZE 0;60,49; "X"
1760 PLOT CSIZE 0;86,64; "2"
1770>PLOT 30,37; "4. DPOKE
     . ELSE.R"
1780 PLOT CSIZE 0;70,27; "o"
1790 INPUT "Numarul atomic
     Za="; LINE j$
1800 FOR i=1 TO LEN j$
1810 IF CODE j$(i)<48 OR
     CODE j$(i)>57 THEN
     GO TO 1790
1820 NEXT i
1830 LET Za=VAL j$
1840 INPUT "Numarul atomic
     ZX="; LINE k$
1850 FOR i=1 TO LEN k$
1860 IF CODE k$(i)<48 OR
     CODE k$(i)>57 THEN
     GO TO 1840
1870 NEXT i
1880 LET ZX=VAL k$
1890 INPUT "Numarul de masa
     Aa?"; LINE l$
1900 FOR i=1 TO LEN l$
1910 IF CODE l$(i)<48 OR
     CODE l$(i)>57 THEN GO
     TO 1890
1920>NEXT i
1930 LET Aa=VAL l$
1940 INPUT "Numarul de masa
     AX="; LINE t$
1950 FOR i=1 TO LEN t$
1960 IF CODE t$(i)<48 OR
     CODE t$(i)>57 THEN
     GO TO 1940
1970 NEXT i
1980 LET AX=VAL t$
1990 LET C=(Za*ZX*e^2)/
     (4*PI*ep*1.45e-15*
     (SQR Aa+SQR AX))
2000 LET C=C/e
2010 CSIZE 8,16
2020 PRINT AT 8,12; "="; C;
     "MeV"
2030 IF W>0 THEN PRINT AT
     10,5;" Nucleul N este
     stabil!"
2040 IF W<0 AND C>mN*
```

```
      931.5   THEN  PRINTAT
      10,3 ; "Nucleul N este me-
      testabil !"
2050  IF W<0 AND C<mN *931
      .5 THEN PRINT AT 10,4 ;
      "Nucleul N este nestabil !"
2060> PAUSE 0 : CLS : GO TO
      690
2070  CLS
2080  PRINT AT 0,9 ; "a+X- >
      Y+b"
2090  PRINT AT 1,7 ; "Energia
      de reactie :"
2100  PRINT '
2110  PRINT AT 3,7 ; "Q=(m+
      m-m-m).c"
2120  PLOT CSIZE 0 ;88,113 ;
      "a XY b"
2130  PLOT CSIZE 0; 194,130 ;
      "2"
2140  INPUT "Introduceti
      ma=" ; LINE q$
2150  FOR i=1 TO LEN q$
2160  IF CODE q$(i)<46 OR
      CODE q$(i)>57 THEN
      GO TO 2140
2170  IF CODE q$(i)=47 THEN
      GO TO 2140
2180  NEXT i
2190  LET ma=VAL q$
2200> INPUT "Introduceti
      mX=" ; LINE w$
2210  FOR i=1 TO LEN w$
2220  IF CODE w$(i)<46 OR
      CODE w$(i)>57 THEN GO
      TO 2200
2230  IF CODE w$(i)=47 THEN
      GO TO 2140
2240  NEXT i
2250  LET mX=VAL w$
2260  INPUT "Introduceti
      mY=" ; LINE r$
2270  FOR i=1 TO LEN r$
2280  IF CODE r$(i)<46 OR
      CODE r$(i)>57 THEN GO
      TO 2260
2290  IF CODE r$(i)=47 THEN
      GO TO 2260
2300  NEXT i
2310  LET m=VAL r$
2320  INPUT "Introduceti
      mb=" ; LINE v$
2330  FOR i=1 TO LEN v$
2340> IF CODE v$(i)<46 OR
      CODE v$(i)>57 THEN
      GO TO 2320
2350  IF CODE v$(i)=47 THEN
      GO TO 2320
2360  NEXT i
2370  LET mb=VAL v$
2380  LET Q=(ma+mX-mY-
      mb) *931.5
2390  PRINT CSIZE 8,16 ; AT
      5,7 ; "Q=" ; Q ; "MeV"
2400  IF Q>0 THEN PRINT
      AT 7,2 ; "Reactia este exo-
      energetica !"
2410  IF Q<0 THEN PRINT
      AT 6,2 ; "Reactia este en-
      doenergetica !"
2420  LET E=(ma+mX) *ABS
      Q/mX
2430  IF Q<0 THEN PRINT
      AT 8,1 ; "E="
2440  IF Q<0 THEN PLOT
      CSIZE 0 ;16,36 ; "prag"
2450  IF Q<0 THEN PLOT
      60,52 ; "---"
2460> IF Q<0 THEN PLOT
      60,60 ; "m+m" : PLOT
      70,36 ; "m"
2470  IF Q<0 THEN PLOT
      CSIZE 0 ;68,47 ; "a X" :
      PLOT CSIZE 0 ;78,23 ;
      "X"
2480  IF Q<0 THEN PLOT
      CSIZE 8,16; AT 8,14; "Q"
2490  IF Q<0 THEN PLOT
```

```
108,49: DRAW 0,-20:
     PLOT 123,49: DRAW 0,
     -20
2500 IF Q<0 THEN PRINT
     AT 8,16; "="; USING
     "000.000"; E;" MeV"
2510 PAUSE 0: CLS: GO TO
     690
2520 SAVE "Enuc" LINE 10
```

8.2. DEZINTEGRAREA RADIOACTIVĂ („DEZRAD")

Un număr de 484 caractere „0", reprezintă tot atîtea nuclee care se dezintegrează în mod aleator atît în spațiu cît și în timp. La intervale de aproximativ 50 secunde, sînt numărate și tipărite nucleele care au rămas nedezintegrate. Tabelul obținut în acest mod este folosit pentru reprezentarea grafică a dependenței numărului de nuclee nedezintegrate în funcție de timp. Folosind tabelul sau graficul, se cere să se determine perioada de înjumătățire și constanta de dezintegrare radioactivă.

```
10 BORDER 2: PAPER 6
20 INK 1: CLS
30 CSIZE 16,24
40 PRINT FLASH 1;AT 3,5;
   "READY"
50 PAUSE 0
60 CLS
70 CSIZE 8,16
80 LET a$="DEZINTEGRA-
   REA"
90 LET b$="RADIOAC-
   TIVA"
100 LET c$="'88 L.HCC"
110 FOR i=1 TO 13
120 BEEP .1,RND*35
130 PRINT AT 4,9+i;a$(i)
140 NEXT i
150 FOR i=1 TO 11
160 BEEP .1,RND*35
170 PRINTAT 5,10+i;b$(i)
180 NEXT i
190 FOR i=1 TO 9
200 BEEP .1,RND*35
210 PRINT AT 6,11+i;c$(i)
220>NEXT i
230 PAUSE 200
240 FOR i=1 TO 120
250 LET 1=4+INT(RND*3)
260 LET c=10+INT(RND*
    12 )
270 IF ATTR (1,c)=49 THEN
    BEEP.1,30
280 IF ATTR (1,c)=49 THEN
    PRINT FLASH 1;AT 1,c;
    " "
290 IF ATTR (1,c)=177 THEN
    PAUSE 20
300 IF ATTR (1,c)=49 THEN
    PRINT FLASH 0; AT
    1,c; " "
310 NEXT i
320 CLS
330 CSIZE 0
340 FOR 1=0 TO 21
350 FOR c0 TO 21
360 BEEP .01,35
370 PRINT AT 1,c; "o"
380 NEXT c
```

```
390 NEXT 1
400 >PLOT 188,175: DRAW
    0,-175
410 PLOT 228,175: DRAW 0,
    -175
420 PLOT 188,164: DRAW
    67,0
430 PRINT AT 0,24; "t(s)"
440 PRINT AT 0,30; "n"
450 LET d=0: LET t=0:
    LET n=484
460 PRINT AT 2,24;t;AT
    2,29; n
470 PAUSE 0
480 POKE 23673,0: POKE
    23672,0
490 DO
500 LET 1=RNDM(21)
510 LET c=RNDM(21)
520 IF ATTR (1,c)=49 THEN
    PRINT FLASH1;AT 1,c;
    "O"
530 IF ATTR (1,c)=177 THEN
    BEEP .01,35
540 IF ATTR (1,c)=177 THEN
    PAUSE 21
550 IF ATTR (1,c)=177 THEN
    PRINT FLASH 0; AT 1,
    c; " "
560 IF ATTR (1,c)=49 THEN
    LET d=d+1
570 >LET n=484-d
580 LET t=INT ((256*PEEK
    23673+PEEK 23672)/50)
590 PAUSE 8500/n^.72-81.5
600 IF t>=47 AND t<=48
    THEN PRINT AT 3,24;
    "50"; AT 3,29; n
610 IF t>=97 AND t<=99
    THEN PRINT AT 4,24;
    "100"; AT 4,29;n
620 IF t>=147 AND t<=
    149 THEN PRINT AT
    5,24; "150"; AT 5,29;n
630 IF t>=197 AND t<=
    199 THEN PRINT AT
    6,24; "200"; AT 6,29;n
640 IF t>=248 AND t<=250
    THEN PRINT AT 7,24;
    "250"; AT 7,29;n
650 IF t>299 AND t<=301
    THEN PRINT AT 8,24;
    "300"; AT 8,29;n
660 >IF t>=349 AND t<=
    351 THEN PRINT AT
    9,24; "350"; AT 9,29;n
670 IF t>=400 AND t<=
    402 THEN PRINT AT
    10,24; "400"; AT 10,29;n
680 IF t>=451 AND t<=
    453 THEN PRINT AT
    11,24; "450"; AT 11,29;n
690 IF t>=501 AND t<=
    503 THEN PRINT AT
    12,24; "500"; AT 12,29;n
700 IF t>=541 AND t>=
    553 THEN PRINT AT
    13,24; "550"; AT 13,29;n
710 IF t>=600 AND t<=604
    THEN PRINT AT 14,24;
    "600"; AT 14,29;n
720 IF t>=650 AND t<=
    654 THEN PRINT AT
    15,24; "650"; AT 15,29;n
730 >IF t>=699 AND t<=
    703 THEN PRINT AT
    16,24; "700"; AT 16,29;n
740 IF t>=748 AND t<=752
    THEN PRINT AT 17,24;
    "750"; AT 17,29;n
750 IF t>=798 AND t<=
    802 THEN PRINT AT
    18,24; "800"; AT 18,29;n
760 EXIT IF t>=800
770 LOOP
780 PAUSE 0
790 FOR 1=0 TO 21
800 FOR c=0 TO 22
```

```
810 PRINT AT 1,c; "  "
820 NEXT c
830 NEXT 1
840 PLOT 10,10: DRAW
    0,165
850 DRAW -2,-3: DRAW
    4,0
860 DRAW -2,3
870 PAUSE 50
880 DEF PROC sun
890>FOR i=1 TO 3
900 BEEP .2,30: BEEP .2,35
910 BEEP .2,40
920 NEXT i
930 END PROC
940 PRINT FLASH 1;AT 1,0;
    "n"
950 PROC sun
960 PRINT FLASH 0; AT
    1,0; "n"
970 PAUSE 50
980 FOR y=40 TO 160 STEP
    30
990 BEEP .1,y/4
1000 PLOT 8,y: DRAW 4,0
1010 NEXT y
1020 PAUSE 100
1030 PLOT 15,20; "0"
1040 PLOT 15,44; "100"
1050 PLOT 15,74; "200"
1060 PLOT 5,104; "300"
1070 PLOT 15,134; "400"
1080 PLOT 15,164; "500"
1090 PAUSE 100
1100 PLOT 10,10: DRAW 170,0
1110>DRAW -3,2: DRAW
    0,-4
1120 DRAW 3,2
1130 PAUSE 50
1140 PRINT FLASH 1; AT
    21,18; "t(s)"
1150 PROC sun
1160 PRINT FLASH 0; AT 21,
    18; "t(s)"
1170 PAUSE 50
1180 FOR x=30 TO 170 STEP
    20
1190 BEEP .1,x/5
1200 PLOT x,8: DRAW 0,4
1210 NEXT x
1220 PAUSE 100
1230 PLOT 38,24;"200"
1240 PLOT 78,24; "400"
1250 PLOT 118,24; "600"
1260 PLOT 58,24; "800"
1270 PLOT 10,10+48.4*3
1280 FOR j=1 TO 17
1290 INPUT "Introduceti valo-
    rile lui n="; LINE n$
1300>FOR i=1 TO LEN n$
1310 IF CODE n$(i)<48 OR
    CODE n$(i)>57 THEN
    GO TO 1290
1320 NEXT i
1330 LET n=VAL n$
1340 IF n<484 THEN DRAW
    10,10+n*3/10-PEEK
    23678
1350 NEXT j
1360 INPUT "Ati gresit? (d/n)";
    a$
1370 IF a$="d" THEN GO TO
    790
1380 IF a$<>"d" AND a$<>
    " n" THEN GO TO 1360
1390 IF a$="n" THEN GO TO
    1400
1400 KEYWORDS 0
1410 LET i=USR "1"
1420 POKE i+0,BIN 00000000
1430 POKE i+1,BIN 00010000
1440 POKE i+2,BIN 00001000
1450 POKE i+3,BIN 00001000
1460 POKE i+4,BIN 00001000
1470 POKE i+5,BIN 00010100
1480 POKE i+6,BIN 00100010
```

```
1490 >POKE i+7,BIN 00000000
1500 CSIZE 8,16
1510 PLOT 70,140; "n=n .e"
1520 PLOT 94,136; "o"
1530 PLOT 122,148; "-LOOP t"
1540 PAUSE 0
1550 PRINT #1;AT 0,0; "Aflati perioada de injumatatire!"
1560 PAUSE 0
1570 PRINT #1;AT 1,0; "Aflati constanta radioactiva!"
1580 PAUSE 0: STOP
1590 SAVE "Dezrad" LINE 10
```

COLECȚIA INFORMATICA

EDITURA DACIA

Urmărind ideea de a implica modernul în metodica predării fizicii, autorul, dascăl cu o bogată experiență didactică, propune elevilor și profesorilor o serie de programe în limbaj BASIC, cuprinzînd o paletă largă de teme din manualele de fizică de liceu.

Concepută ca un instrument ajutător în predarea și însușirea lecțiilor, lucrarea prezintă programe astfel realizate încît să fie accesibile și unui începător, putînd fi folosite pe orice calculator personal compatibil cu HC-85.

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